

## TAXONOMIC FERN-STUDIES I-II.

BY

CARL CHRISTENSEN.

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- I. Revision of the polypodioid Genera with longitudinal Coenosori (*Cochlidiinae* and "*Drymoglossinae*"); with a discussion of their phylogeny. With 13 plates.
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# I.

## Revision of the polypodioid Genera with longitudinal Coenosori (*Cochlidiinae* and "*Drymoglossinae*"); with a Discussion of their Phylogeny.

With 13 Plates.

"The soral characters upon which they were based really represent states or conditions arrived at by evolution along a plurality of converging lines. Consequently an increased difficulty arises in the segregation of the distal evolutionary twigs." (F. BOWER: The Ferns vol. III pag. 3. 1928).

The term *Coenosorus* was given by Prof. K. GOEBEL<sup>1)</sup> to such sori as are formed by fusion of two or more single sori. Such coenosori, short or long, are found in most of the larger groups of Polypodiaceæ, being the normal sori in some (*Pteridæ*, *Blechnæ*); in others single sori are the rule, but here and there species or groups of species with coenosori occur, and in most cases it is evident that such species are derived from or closely related to others with single sori. In the subfamily *Polypodiæ* we find two kinds of coenosori, longitudinal, running parallel to the midrib of the frond or a pinna, and transversal, running parallel to the primary lateral veins from the midrib to the edge. The latter kind is found in the genera (or subgenera of *Polypodium*) *Selliguea* and *Loxogramme*, the former in the tribe *Taenitidinæ*. In the present paper only the polypodioid ferns with longitudinal coenosori will be dealt with, and the tribe *Taenitidinæ* as a whole is the first object of the following considerations.

### 1. On the *Taenitidinæ* of Diels.

The *Taenitidinæ* is the first tribe of the subfamily *Polypodiæ* in Diels's classification of the Polypodiaceæ in "Die natürlichen Pflanzenfamilien", the second and last being the *Polypodiinæ*. It

<sup>1)</sup> Organographie, 2. Ausg. (1915) p. 1137.

is characterized by the sporangia being borne on linear continuous receptacles running parallel to the midrib (coenosori), while the *Polypodiinæ* have round or oblong sori on distinctly separated receptacles. To the *Tænitidinæ* Diels referred six genera: *Drymoglossum*, *Dicranoglossum* (= *Eschatogramme* Trev., Ind. Fil.), *Taenitis*, *Platytaenia*, *Heteropteris* (= *Paltonium* Presl, Ind. Fil.) and *Hymenolepis*. In my Index Filicum, where I followed Diels's classification on the whole, two more genera were added to the tribe: *Drymotaenium* Mak. and *Christopteris* Copeland.

The grouping of these genera together into one tribe is, however, unnatural and inconsistent. A very important character of the subfamily *Polypodiæ* is that the leaves are articulated to the rhizome, but DIELS himself says in the description of *Taenitis* and *Platytaenia*: "Stiel dem Rhizom ungegliedert angefügt". It must be admitted that it would not be unnatural to place the two genera in the *Polypodiæ*, if they agree in all other important characters with the other members of the subfamily, but an examination of the two genera will quickly convince everyone that the only character in which they are similar to the other genera of the tribe is found in the linear longitudinal sori. In the anatomical structure of the rhizome which is clothed with characteristic hairs, not with scales, by the very regularly netted veins, by the sporangia being borne on epidermal cells without a true receptacle connected with the veins, and in general habit, the few species of these two genera are widely different from those of the others<sup>1</sup>). Long ago MAX. KUHN placed the two genera in his group *Chaopterides*, while *Drymoglossum* etc. belong to his *Lepidopterides*<sup>2</sup>), and in this he was right. If these two series of ferns so named represent two separate lines of evolution, as I now, like Prof. BOWER, believe to be the case, it is clear that Diels's classification is unnatural, and by his recent studies Prof. GOEBEL arrived at the same conclusion<sup>1</sup>). The genera *Taenitis* and *Platytaenia* must be excluded from Diels's group *Tænitidinæ* as well as from the subfamily *Polypodiæ*, and the name for the tribe including the remaining genera must accordingly be changed if it can be proved that these genera form a natural unit of close relationship. Preliminarily I call this group the

<sup>1</sup>) On *Taenitis* see GOEBEL: Ann. Jard. Bot. Buitenzorg 35: 128-140, pl. X—XI. 1926.

<sup>2</sup>) Die Gruppe der *Chaopterides*. Berlin 1882.

"*Drymoglossinæ*". Still the natural systematic position of the genuine *Taenitidinæ*, including the two often mentioned genera and probably one or two more, is not quite clear. Their relationship and probable origin have been discussed by GOEBEL in the paper quoted above; he is of opinion that among recent ferns they come next to the *Pteridinæ* but that it is not proved that they are phylogenetically related to that group; with the latter statement I fully agree. No more will be said about the group in the present paper, in which I will try to give a systematic revision of the "*Drymoglossinæ*".

## 2. Are the "*Drymoglossinæ*" a natural group?

Having excluded *Taenitis* and *Platytaenia* from the first tribe of *Polypodiæ*, now called the "*Drymoglossinæ*", the remaining six genera referred to it in Index Filicum correspond to the main characters ascribed to the tribe. One of these genera, *Christiopteris* Cop., must, however, also be excluded. According to COPELAND<sup>1)</sup>, this genus is an acrostichoid derivative of *Phymatodes* and the type-species (*C. sagitta* Cop.) congeneric with *Leptochilus tricuspidatus* (Hook.) C. Chr., which species was studied elaborately by F. BOWER<sup>2)</sup>, who found it so different from the other species of *Leptochilus* that he proposed to make it the type of a monotypic genus (*Gymnopteris*). In his large work, *The Ferns* (III: 213-218, 1928), he summarizes his results, now using the better name *Christiopteris tricuspis* (Hook.) Christ, and associates the genus with *Cheiropleuria* and *Platycerium*. The number of genera belonging to the "*Drymoglossinæ*", hitherto recognized, is thus five, to which must be added a sixth, recently described, *Grammatopteridium* v. A. v. R.

These six genera agree with *Polypodium* in most characters, differing by their longitudinal coenosori. The same may, however, be said of some other ferns, hitherto referred to the subfamily *Vittariæ*. The genuine *Vittariæ* form a very natural group, well marked by a number of characters recently studied in detail by K. GOEBEL<sup>3)</sup> and S. WILLIAMS<sup>4)</sup>, f. inst. the very characteristic

<sup>1)</sup> The genus *Christiopteris*. Philipp. Journ. Sci. **12** C: 331-336. 1917.

<sup>2)</sup> Ann. of Bot. **21**: 1-39. 1917.

<sup>3)</sup> Vittariaceen and Pleurogrammaceen. Flora **117**: 91-132. 1924.

<sup>4)</sup> A critical examination of the *Vittariæ*, with a view to their systematic comparison. Trans R. Soc. Edinburgh **55**: 173-217. 3 pl. 1917.

clathrate scales, the peculiar spicule-cells of the epidermis, the paraphyses, the lobed and gemmiferous prothallia and others. The *Vittariæ* cannot, therefore, be near relatives of the "*Drymoglossinæ*" though agreeing with them in having longitudinal coenosori. The latter group may be characterized negatively by its lack of the characters special to the *Vittariæ*, and just the same may be said of two groups of species, by DIELS and others referred to the *Vittariæ*, viz. *Monogramme* Sect. II *Pleurogramme*, to which group also belong the American species of *Eumonogramme* Diels, and a small group of Asiatic species of *Vittaria*, to which VAN ALDERWERELT VAN ROSENBURGH some years ago gave the name *Scleroglossum*. These two groups together with two genera of recent date, *Oreogrammitis* Cop. and *Nematopteris* v. A. v. R., must be excluded from the *Vittariæ* and referred to the *Polypodiæ*. Important characters prove that they are polypodioid ferns with longitudinal coenosori as are the "*Drymoglossinæ*".

The described polypodioid genera with longitudinal coenosori are thus ten:

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|-------------------------------------|--------------------------------------|
| 1. <i>Oreogrammitis</i> Cop.        | 6. <i>Grammatopteridium</i> v.A.v.R. |
| 2. <i>Pleurogramme</i> Presl.       | 7. <i>Drymotaenium</i> Mak.          |
| 3. <i>Scleroglossum</i> v. A. v. R. | 8. <i>Hymenolepis</i> Klf.           |
| 4. <i>Nematopteris</i> v. A. v. R.  | 9. <i>Paltonium</i> Presl.           |
| 5. <i>Drymoglossum</i> Presl.       | 10. <i>Eschatogramme</i> Trev.       |

Most of these genera are usually recognized as good ones, but the following questions now arise:

- 1) whether they are really so closely related to each other that they should naturally be placed together in a single tribe, or perhaps in two tribes,
- 2) whether this tribe (or tribes) may be upheld as a natural one (ones),
- 3) whether the genera are all well founded or delimited.

These questions I have tried to settle by a comparative study of practically all described species referred by authors to the aforesaid genera. My results are based on an examination of the very comprehensive material contained in the larger herbaria, the authorities of which have kindly sent it to me on loan, and I wish here to express my best thanks to the directors of the following herbaria:

- B* = Botanisches Museum, Berlin/Dahlem.  
*Bog* = Herbarium Bogoriense, Botanic Garden, Buitenzorg, Java.  
(Some type-specimens.)  
*BP* = The Hungarian National Museum, Budapest.  
*BSci* = Bureau of Science, Manila; by the courtesy of Dean Merrill, Berkeley.  
*Cal* = Herbarium of the University of California, Berkeley, Cal.  
*CC* = Herbarium Carl Christensen.  
*H* = Botanical Museum, Copenhagen.  
*Kew* = Royal Botanic Gardens Kew.  
*L* = Rijksherbarium, Leiden.  
*Le* = Herbarium of the Principal Botanical Garden, Leningrad.  
*P* = Muséum d'Histoire naturelle, Paris.  
*RB* = Herbarium Roland Bonaparte, Paris.  
*S* = Riksmuseets paläontologiska Avdelning, Stockholm.  
*SB* = Herbarium Selim Birger, Stockholm (including the greater part of Herb. Rosenstock).  
*Si* = Botanic Gardens, Singapore.  
*U* = Herbarium of the University, Utrecht.  
*W* = U. S. National Herbarium, Washington.  
*Wi* = Nationalmuseum, Wien.

From most of these herbaria I have had their whole material of the genera dealt with, *Paltonium* only excepted, and I have examined a large number of specimens of most species, still some of the recently described species are represented by a rather scanty material, which I could not examine in detail without damaging the specimens. My results concerning such species are, therefore, perhaps inconclusive. Under the different species I have quoted most specimens seen, often indicating by the abbreviations shown above the herbaria in which they are contained. As my studies on these ferns began two years ago, it is possible that I have given some specimens names which I have changed later on. Such names should be replaced by those used in this paper.

There remains to me the pleasant duty of thanking Mr. J. BOYE PETERSEN for his assistance in clearing the venation of some species and for his very exact drawings of the anatomical structure.

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It is mentioned above that the ten genera enumerated at pag. 6 agree in nearly all characters with members of the tribe *Polypodiinæ*, and without further discussion it must be taken as granted that they are genuine *Polypodieæ*. They all differ from the *Polypodiinæ* by having longitudinal coenosori parallel to the midrib, and it will now be discussed if this character may be considered so important that a separate tribe may be based upon it alone.

The normal linear receptacle containing a vascular bundle runs continuously parallel to the midrib in the fertile (generally the upper) portion of the leaf, often crossing the veins; as in other *Polypodieæ* the sporangia is never protected by an indusium, but frequently the receptacle is sunk in a deep groove in the leaf-tissue. In some species the receptacle is very close to the midrib, in others apparently marginal, still in most species it runs between the midrib and the edge. The position of the receptacle or sori is rather constant in some genera, while in others, f. inst. *Scleroglossum*, it is variable, and it cannot, therefore, be regarded as a reliable generic character. The relation between the receptacle and the veins has been studied by GOEBEL in *Pleurogramme* (incl. *Scleroglossum*), *Hymenolepis* and *Drymoglossum*, and I must confine myself to referring to his papers quoted above. His results are fully in accordance with those gained by myself during studies of the external morphology.

Besides by the longitudinal coenosori nearly all species belonging to the ten genera agree in having entire fronds; only the species of one genus (*Eschatogramme*) have normally furcate or subpinatifid leaves, and in some species of *Cochlidium* forked fronds are common. As to most other important characters: the structure of the dermal appendages and paraphyses, venation, mode of growth and also general habit, the genera are so widely different that the segregation of the species into several genera seems very natural. These characters will be mentioned below under the different genera, but it must here be pointed out that some of the genera are so decidedly different from each other, that a close genetical relationship between them *a priori* seems very improbable, notwithstanding their likeness in soral characters. It must, therefore, be examined, if these characters are of such value as tribal ones that one feels compelled to consider them the prime ones and regard the differences as being of minor value.

Now, it is remarkable that nearly all genera of the "*Drymo-*

*glossinæ*" are monotypic, at least if taking the species in a wide sense. If the view is right that the oldest ferns were of the pinnate type, wherefrom the forms with simple fronds were derived during the later geological periods, and adapted to an epiphytical habitat and a moist tropical climate, the "*Drymoglossinæ*" must be ferns of a proportionally recent origin as are probably most or all *Polypodiæ*. This being the case it would be rather unique in the plant-world that a series of ferns of recent origin and originating from the same source, which they must be if really closely related genetically, should be so different as to most features. The hypothesis of WILLIS on the origin of new genera through mutation could, of course, explain this remarkable series of genera, but his theory is in my opinion based upon misunderstandings and wrong interpretations of facts. As far as my experience goes no facts confirming his theory can be found in the fern-world but several go directly against it. Even if his theory were accepted, it would seem beyond probability that a new generic mutant should arise, which has lost nearly all the characters of its ancestors and acquired a set of new ones, which are all or nearly all found together in other existing ferns. For this is indeed the case here, and here we have the key to the right understanding of the "*Drymoglossinæ*".

While the genera of the tribe are so different that it seems improbable that they can be narrowly related, it will be shown in the following that each genus as to all important characters, the coenosori excepted, strikingly resembles single species or narrow groups of species now referred to the large genera *Polypodium* and *Cyclophorus*, both belonging to the *Polypodiinæ*, thus normally having single sori. In several cases a "drymoglossoid" species is so like a "polypodioid" one that both can scarcely be determined in a sterile state. When an assemblage of several important characters occurs in different species, it seems justifiable to consider them near relatives, even if they apparently differ greatly in soral characters. If now these soral characters are stable ones, the question as to the nearer or more remote alliance of such species becomes difficult, but in the present case this difficulty does not exist, because the characters: coenosori and single sori, are very unstable ones within the *Polypodiæ*. On one side we find several species of *Polypodium* and *Cyclophorus*, in which two or more sori are often confluent, thus forming coenosori, and on the other hand in several "drymoglossoid" species the coenosori are

interrupted often to such a degree that most sori are perfectly polypodioid. Examples of this aberration from the normal state will be mentioned below.

From the above considerations I conclude that the "*Drymoglossinæ*" cannot be considered a natural group of genera, because 1) the only character ascribed to it, the coenosori, is a very unstable one and is also found in several species of the *Polypodiinæ*, and 2) in all other characters the different genera show a close resemblance to different groups of the *Polypodiinæ* in which they evidently have their nearest relatives, while inter se they are utterly different. The whole tribe must disappear from the "system", and its genera be incorporated in the *Polypodiinæ*. Here, however, we meet with the greatest difficulty.

The *Polypodiinæ* is a very large tribe, containing about ten genera with nearly 1500 described species, the great majority of which belong to the genus *Polypodium*, and a century to *Cyclophorus*. Whether or not the tribe is a natural one shall not be discussed here, probably it should be divided into several smaller ones. To this tribe the "drymoglossoid" genera should now be referred, but the question is where to place them, if we wish to arrange the genera in a natural series with each placed between those to which it is most closely related. Such a linear arrangement is, however, impossible, if we retain *Polypodium* in the broad sense of my Index Filicum. In my paper on *P. vulgare*<sup>1)</sup> I have pointed out that this vast genus ought to be divided into a fair number of smaller genera, and several authors have tried to define such but no one has succeeded in giving a classification of the species which has been generally adopted. The fault has nearly always been that the smaller genera, as now the subgenera, were based upon the venation. This is a most important character, it must be admitted, but it is not sufficient for a natural grouping of the species; in my opinion the dividing line should be drawn so to say longitudinally through the whole genus, so that some of the new genera will contain as well species with free as with anastomosing veins.

As mentioned above, the drymoglossoid genera have their nearest relatives in certain groups of species now referred to *Polypodium* and *Cyclophorus*. We cannot, of course, place the genera

<sup>1)</sup> Dansk Botanisk Arkiv 5, no. 22. 1928.

among the species of other genera, but a natural classification must be possible. We can proceed in two different ways in order to reach it. We can simply refer the drymoglossoid species to the two large genera, placing them in the groups that contain their relatives, or we can deal with these groups as distinct genera and place the drymoglossoid genera by their side. Both methods are equally natural, but the latter must, I believe, be preferred. No one wishes to add a new series of species to so large a genus as *Polypodium*, if it can be avoided, and as most drymoglossoid genera are easily recognized, I prefer to retain them as genera. True, we still lack the definitive delimitation of the corresponding polypodioid genera, but it will certainly come, and till that time we must be content to place the drymoglossoid genera in an appendix to *Polypodium*, by each pointing out explicitly with which group of species of the large genus they should be associated. This I shall do in discussing the third question (page 6): are the drymoglossoid genera well-founded or delimited? The reply to that question must be given for each genus separately in the following special part of this paper, in which I give a systematic critical review of all "drymoglossoid" genera together with a revision of the known species.

In the foregoing considerations my answers are given to the first and second question (see pag. 6); briefly they are:—

- 1) The genera dealt with in the following are so different that they cannot be considered genetically close relatives,
- 2) a tribe "*Drymoglossinæ*" cannot be upheld as a natural one.

In the concluding part of this paper I shall show how the accepted genera should be placed in a natural manner, still it is practical already here to point out that the four first-named genera (see pag. 6) are so closely related that they must naturally be grouped together into a special tribe, the *Cochlidiinae*.

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Concluding these general remarks I shall call attention to some ferns which are not included in the following revision of the drymoglossoid genera, though they apparently agree with them in soral characters.

*Loxogramme dimorpha* Copeland. The fertile leaf of this remarkable species is very much contracted, long, linear, with

a distinct continuous receptacle parallel to the midrib on each side, just as in most drymoglossoid genera, but the sterile leaves, rhizome and roots fully agree with other species of the genus, some of which have the fertile leaves considerably contracted, still all with the characteristic oblique coenosori of the genus. The systematic position of this is doubtful to me; perhaps it does not belong to the *Polypodiæ* at all, among other things it differs from the genuine polypodioid genera by the leaves not being articulated to the rhizome. It is interesting to note that within this genus, too, we find a species with drymoglossoid coenosori.

*Leptochilus axillaris* (Cav.) Klf. The very much contracted, linear fertile leaf seems superficially to be drymoglossoid, but it is generally believed that it is an acrostichoid fern with the sporangia borne on the whole underside<sup>1)</sup>. I am by no means sure that this is the case, and perhaps *Leptochilus* Klf. taken in a very narrow sense including *L. axillaris*, *L. minor* and some few others, should be placed among the drymoglossoid genera.

*Hemigramma*. In this genus some drymoglossoid forms are to be found, f. inst. *Leptochilus hilocarpus* Fée, *Acrost.* pl. 48, fig. 1, which is by most authors believed to be a form of *H. latifolia* with simple fronds. The very narrow, linear fertile leaves seem not essentially different from the common drymoglossoid type, but it is said that they are really acrostichoid. The short rhizome with adherent leaves, texture, venation, scales and other characters show, however, that these forms are not polypodioid ferns but acrostichoid, eventually drymoglossoid derivatives from some aspidioid source. Several aspidioid ferns have by contraction of the fertile leaf arrived at an acrostichoid state, and it is not surprising if drymoglossoid forms are to be found in the subfamily *Aspidiæ*.

### Cochlidiinae (*Pleurogrammaceæ* Goebel).

To this tribe or group belongs a small number of tropical American and Asiatic-Polynesian species, with which pteridologists have dealt very differently as to their systematic position, though nearly all have placed them in the tribe *Vittariæ*.

<sup>1)</sup> FÉE, *Gen. Fil.* pl. III B.

The oldest genus founded upon one of these species (*Grammitis graminoides* Sw.) is *Cochlidium*, adequately described by KAULFUSS in 1820 and in 1824 (Enum. 86). Some years before DESVAUX had referred the same species to *Monogramma* Schkuhr (Berl. Mag. 5: 303, 1811), in which genus it has until now been placed as *M. graminoides* by nearly all authors. In 1827 (Prodr. 217) the same author created a new genus *Micropteris*, to which he referred four species, among them *Polypodium serrulatum* Sw. and *Blechnum seminudum* Willd., the latter, as we now know, being identical with *Taenitis linearis* Klf. This was referred by BLUME to *Antrophyum* as the type of a special section, to which he gave the name *Pleurogramme* (Fl. Javæ Fil. 69. 1828), and this name was used by PRESL (Tent. 223. 1836) as a generic one for a small group of South American ferns, his type being *Taenitis linearis*. While FÉE (3rd and 5th mém.) followed PRESL and maintained *Pleurogramme* as a genus of the tribe *Vittariæ*, HOOKER (sp. 5: 124) reduced it to a section or subgenus of *Monogramma*. METTENIUS was the first author who segregated these species from the *Vittariæ* and referred them to *Taenitis*, but no one but KUHN has followed him in this. Although CHRIST (Farnkr. 54. 1897) treated *Pleurogramme* as a genus distinct from *Monogramma* he still placed it in the tribe *Vittariæ*, and finally DIELS, in "Die natürl. Pflanzenfamilien", reverted to HOOKER's classification, making *Pleurogramme* a section of *Monogramma* but referring some species really belonging to it to *Eumonogramma*. DIELS's classification was followed in my Index Filicum, and most of the few species described later were called *Monogramma*.

While the American species have thus by most authors been referred either to *Monogramma* or to *Pleurogramme*, the Asiatic ones have all been referred to *Vittaria*, thus by BLUME, KUNZE, FÉE, HOOKER, CHRIST and DIELS (and Index Fil.); only METTENIUS placed them in *Taenitis*. These species are evidently so closely related to the American *Pleurogramme* that I am surprised to find that CHRIST was the first author who referred a couple of them to that genus. He was followed by COPELAND and in 1912 v. A. v. ROSENBURGH founded upon the Asiatic species the genus *Scleroglossum*, apparently without knowing its close resemblance to *Pleurogramme*. He placed his new genus in *Vittariæ*. In 1918 the same author described another genus *Nematopteris* which is no doubt nearly allied to *Scleroglossum*.

From this short review of the systematic history of these ferns it will be seen how different the opinions about them have been. Because of the *Vittaria*-like habit and sori of the species nearly all writers have placed them in the *Vittariaceæ*; the old idea that soral characters must form the principal base of the classification has here, as elsewhere, concealed the real relationship of these species. It is strange, because they are totally different from the genuine *Vittariaceæ*. This was mentioned briefly by RALPH C. BENEDICT in his first paper on *Vittaria*<sup>1)</sup>, and he was the first modern pteridologist who excluded *Pleurogramme* from the *Vittariaceæ*. That he was right was recently fully proved by GOEBEL, who examined species of this group in a detailed and comparative manner<sup>2)</sup>, and from my own studies I have arrived at the same conclusion.

The *Cochlidiniæ* (or *Pleurogrammineæ*) differ from the *Vittariaceæ* by the following characters: 1) Rhizome erect, containing sclerenchyma, clothed with light-brown (rarely dark-brown) scales which are not clathrate and generally hidden between the leaf-bases, 2) leaves densely tufted (articulate?), when old of woody, hard texture, without spicule-cells, 3) sori without paraphyses, 4) sporangia with two stomium-cells (in *Vittaria* 4). Also the venation is different, and other differences were pointed out by GOEBEL. The coenosori are confined to the upper third or half of the frond, parallel to the midrib, superficial or immersed, close to the costa in some species, medial or intramarginal in others. Spores tetraëdric; they contain chlorophyll and often germinate within the sporangia (cf. GOEBEL l. c. 122).

Although it must be admitted that some species habitally and in sorus-characters resemble *Vittaria*, this resemblance is certainly not a proof of their close alliance with that genus, and the characters mentioned above are in my opinion so important, that the group cannot naturally be associated with the *Vittariaceæ*. Before discussing its relationship I shall, however, try to solve two other questions: 1) Do the American and Asiatic species belong to the same genus? and 2) which name shall we give to this or eventually these genera?

As to the first question GOEBEL is of opinion that the American and Asiatic species are very closely related, and to him it is a

<sup>1)</sup> Bull. Torr. Bot. Club 38: 156. 1911.

<sup>2)</sup> Vittariaceen and Pleurogrammaceen. Flora 1924, p. 91 ff.

matter of convenience whether we refer them to one or to two genera. He has found some less important differences in the anatomical structure and venation and small paraphyses in an Asiatic species (*Pl. Loheriana*; they have not been observed by me). If the Asiatic species as to all other characters fully agree with the American ones, these differences probably do not justify their segregation, but a more important difference is found in the soral characters.

The sori of the American species are always very close to the midrib, in some superficial, in others immersed in a groove, in which both sori are sunk; thus the edges of this groove are both the outer ones and they are sometimes somewhat produced toward the midrib, covering the young sori (cf. GOEBEL l. c. fig. IX p. 118). The sporangia are borne on the basal portion of the fertile veins, which, contrary to the sterile ones, first run upward and nearly parallel to the midrib before diverging toward the margin (GOEBEL fig. II p. 118); in some species the fertile veins do not anastomose and the sori are then really interrupted, but very early the sporangia form a continuous line, in other forms the ascending basal portions of the veins are connected by a short fertile vein, and thus a long fertile vein is formed parallel to the midrib (cf. GOEBEL fig. 12 I, p. 120), the sori, therefore, are continuous. These anastomosing fertile veins are, however, rarely found, even in the species examined by GOEBEL. A real linear receptacle containing a "Kommissuralnerv" beneath the veins is (always?) wanting.

The sori of the Asiatic species are always immersed in two distinct oblique grooves, the mouth of which opens toward the margin, never close to the midrib but often quite marginal; the edges of the grooves are sometimes equal but often the inner one is produced and protects the young sori. No essential difference between sterile and fertile veins is to be found; the sporangia are borne on a linear receptacle containing a "Kommissuralnerv" (cf. GOEBEL fig. I p. 118).

Because of these differences between the two groups of species together with others less important I find it natural to maintain two genera, one including the American, the other the Asiatic-Polynesian species. The name of the American genus must be *Cochlidium* Kaulf., which is 8 years older than *Pleurogramme* Bl.; it was, therefore, rightly preferred by MAXON in his important

work on the Pteridophyta of Porto Rico 1926. The only available name for the other genus is *Scleroglossum* v. A. v. R. Besides these two genera a third, *Nematopteris* v. A. v. R. should presumably be added to the group, which I call *Cochlidiinae*, as the old name *Pleurogrammeæ* is unsuitable one, when *Pleurogramme* is reduced to a synonym.

The discriminating characters of the group and its three genera may briefly be described thus:

### Cochlidiinae.

Small epiphytic ferns with an erect, cylindrical rhizome, which contains a central vascular bundle surrounded by a ring of sclerenchyma; the scales bright-brown, not clathrate, hidden among the leaf-bases. Leaves tufted, not distinctly articulate to the rhizome, narrow, linear, entire or forked, coriaceous, when old of hard, woody texture, without spicule-cells, the veins hidden, simple or forked, free, rarely anastomosing, sometimes suppressed. Sporangia with two stomium-cells, forming two confluent or distinct exindusiate coenosori parallel to the midrib in the apical portion of the frond; paraphyses none or rudimentary; spores tetraëdric-globose, containing chlorophyll.

1. *Cochlidium*. Coenosori close to the midrib, superficial or immersed in a single central groove, confluent, the sporangia borne on the ascending basal part of the fertile veins. Fronds and sporangia glabrous. — American species.
2. *Scleroglossum*. Coenosori immersed in two distinct oblique grooves, one on each side of the midrib, their mouths medial between midrib and edge or marginal; sporangia borne on a linear receptacle beneath the veins, glabrous. Young fronds (always?) furnished with stellate hairs. — Tropical Asia, Australia and Polynesia.
3. *Nematopteris*. Sori immersed in deep open grooves, which in one species are divided by cross-walls into several oblong pits. Leaves rush-like with the veins without sclerenchyma. — Borneo, New Guinea.

1. *Cochlidium* Kaulfuss.

Berlin Jahrb. Pharm. 21: 36. 1820<sup>1</sup>); Enum. Fil. 86. 1824;  
MAXON: Pteridophyta of Porto Rico 406. 1926.

*Antrophyum* sect. *Pleurogramme* Blume, Fl. Javae Fil. 69. 1928.

*Pleurogramme* Presl, Tent. Pterid. 223. 1836.

*Micropteris* Desv. Mém. Soc. Linn. Paris. 217. 1827, pro parte.

*Monogramma* sp. auctt., C. Chr. Ind. Fil.

Type-species: *Grammitis graminoides* Sw.

To the short description given above little needs to be added. The short or sometimes lengthened scaly rhizome here and there shoots short branches, by which the plant propagates vegetatively, and often a number of individuals are found growing close together in dense clumps between mosses on tree-trunks. The leaves are apparently long-living and long adherent to the rhizome, becoming very thick with age, but fragile, and blackish. The percurrent costa is strongly sclerotic, concealed by parenchyma, the veins immersed, rarely subdistinct, simple and ending in a hydathode within the edge, sometimes extremely short, or furcate and sometimes united and forming large costal areoles without free included veinlets. Sori linear coenosori, rarely much interrupted (polypodioid), the sporangia borne on the fertile veins close to the costa at either side, the double line early confluent, sometimes intermittent. Forking of the fronds is a feature frequently met with in all species, and in one or two species the larger fronds seem to be normally once or twice furcate.

To this genus belongs a small number of forms which are closely related, and their delimitation is difficult. Below I describe 8 species, but that number is perhaps too large, as some species are connected by intermediates and others can only be distinguished by the size, an unsafe character. As in other genera, dealt with in this paper, the linear arrangement of the sori is no stable character, the sori being often interrupted, although rarely fully polypodioid. Because of this fact I refer to *Cochlidium* a species,

<sup>1</sup>) Dr. MAXON has kindly sent me KAULFUSS' original description, published in that little known periodical. It runs: "*Cochlidium*. Eine kurze einzelne Fruchtlinie steht in der Mitte auf dem löffelförmigen Ende des einfachen oder zweifachen linienförmigen Laubes. *Grammitis graminoides* von Jamaika bildet diese Gattung".

hitherto referred to *Polypodium* (*P. dicranophyllum* C. Chr.) which as to all characters, the polypodioid sori excepted, agrees closely with the other species of this genus.

The species of *Cochlidium* are poorly represented in most herbaria, scarcely because they are rare but because the small plants are rarely detected in their haunts between mosses. The genus is probably represented in all mountainous regions of tropical America, but hitherto it is very rarely found in the South American Andes. Its head-centres seem to be: Southern Central America, the Lesser Antilles and Southeast Brazil.

#### Key to the Species.

1. Sori superficial ..... 2  
Sori immersed in a central groove ..... 7
2. Sori polypodioid, oblong, leaves often forked..... 3 *C. furcatum*  
Sori linear coenosori, rarely much interrupted..... 3
3. Veins nearly suppressed, reduced to extremely short spurs on either side of the midrib; leaves 0.5—1 mm. broad ..... 4  
Veins reaching at least halfway to the edge; leaves 1—5 mm. broad ..... 5
4. Larger fronds once or twice furcate, the apical fertile portion dilated, concave ..... 1 *C. graminoides*  
All fronds simple, very narrow below, the fertile portion conduplicate ..... 2 *C. pumilum*
5. Veins of the sterile portion of the fertile leaf normally simple; leaves flat ..... 6  
Veins of the sterile portion forked, not anastomosing in the fertile part; leaves mostly conduplicate ..... 6 *C. paucinervatum*
6. Fronds 2—8 cm. long, 1—2 mm. broad, the margins often sinuate ..... 4 *C. minus*  
Fronds 8—20 cm. long, 2—5 mm. broad, entire; veins of the fertile portion sometimes anastomosing close to the midrib ..... 5 *C. seminudum*
7. Leaves flat and usually straight; veins simple, parallel, terminating in a distinct hydathode ..... 7 *C. linearifolium*  
Leaves usually conduplicate and curved; veins curved upwards, sometimes anastomosing ..... 8 *C. rostratum*

1. *Cochlidium graminoides* (Sw.) Kaulf. Enum. 86. 1824. — Plate I fig. 1, III fig. 1.

*Acrostichum graminoides* Sw. Prodr. Fl. Ind. occ. 128. 1788.

*Grammitis graminoides* Sw. Syn. 22 pl. 1 fig. 5. 1806.

*Monogramme graminoides* Bak. Syn. Fil. 375. 1868; C. Chr. Ind. 430 with synonyms.

Type from Jamaica, leg. SWARTZ (*S!*, cotypes in *H* and *Le*).

Scales bright-brown, thick, rigidly hair-pointed. Leaves 2—4 cm. long, 0.5—1 mm. broad, simple or the larger commonly once or twice furcate, somewhat widened toward the subspatulate, conduplicate or concave acutish apex; costa raised above, less so, yet distinct, beneath; veins nearly quite suppressed, appearing as mere spurs at both sides of the costa. Sori confined to the apical conduplicate or concave portion, mostly short, close to the midrib, early confluent in a single line.

*C. graminoides* is evidently an extremely rare species. It was gathered by SWARTZ one and half a centuries ago, but never found by JENMAN, HARRIS, UNDERWOOD, MAXON and other collectors of Jamaican plants; only a specimen in the British Museum collected by WILLIS belongs to SWARTZ' type<sup>1</sup>). This is strange, because the species is very often mentioned, described and even illustrated<sup>2</sup>) in the pteridographical literature and by authors referred to not less than nine genera (see Index Fil.), although several of them have never seen a specimen of the genuine *C. graminoides*, but probably they have referred forms of other species with forked fronds to it. In HOOKER and BAKER Syn. Fil. p. 375 it is stated that the species is found in "Jamaica, Brazil and St. Helena and reported from Chili by GAY". Asking for specimens from these localities I received from Kew a single specimen which does not belong here but to a new species described below. All these peculiar circumstances led me to the idea that the specimens gathered by SWARTZ are somewhat abnormal ones and really belong to the small species described by JENMAN as *Monogramme minor*. I have had some correspondence with Dr. MAXON about this; he is of opinion that *M. minor* is a different species and after fresh examinations of the material I consider it best to maintain the two species as valid ones, although I am by no means convinced that they really are so; especially the specimens from Cuba referred below to *C. minus* (Jenm.) Maxon come very near to *C. graminoides*. The distinctive characters of this are the extremely short veins, the thicker scales, and the dilated apical fertile portion of the leaves.

## 2. *Cochlidium pumilum* (Massee) C. Chr. sp. nov. — Plate III fig. 3.

*Monogramme pumila* Massee ms. in herb. Kew.

Rhizome slender, erect, 2 cm. high, the scales bright-brown, lanceolate, thin, hair-pointed; leaves densely tufted, 4—5 cm. long, all simple, from the thread-fine base very gradually widened toward the acute tip, scarcely 1 mm. wide in the upper broader part, which is conduplicate. Veins nearly perfectly suppressed, still shorter than in *C. graminoides*. Coenosori mostly interrupted into 3—4 oblong patches, superficial.

Ecuador: Chuquiri bamba, GEO. EDW. MASSEE, Sept. 9th, 1868, (*Kew*).

Certainly nearly allied to *C. graminoides*, but the leaves extremely narrow below the fertile portion and all simple. From *C. rostratum* it differs by superficial sori and suppressed veins.

<sup>1</sup>) Dr. MAXON has kindly sent me a photograph of WILLIS' specimen.

<sup>2</sup>) F. inst. in Fl. Bras. 1<sup>2</sup> pl. 48, fig. 4.

3. *Cochlidium furcatum* (Hook. and Grev.) C. Chr. comb. nov.  
*Grammitis furcata* Hook. and Grev. Ic. Fil. pl. 62. 1828.  
*Polypodium furcatum* Mett. Polyp. no. 9. 1857 (not Desv.).  
*Polypodium dicranophyllum* C. Chr. Ind. 522.

Type from British Guiana l. PARKER (*Kew!*).

This species differs from *C. graminoides* by the long segments of the forked leaves and by the polypodioid, oblong sori; it is often larger, thinner in texture, the margins more distinctly sinuate, and the veins much longer but as to other important characters: mode of growth, scales etc., it agrees with *C. graminoides*, so it seems quite natural to place it in this genus. On the other hand I am not sure that the specimens referred here all belong to the same species.

Trinidad: Las Lapas Road (A. HOMBERSLEY 277, W).

British Guiana: s. l. (PARKER, *Kew*), Mt. Roraima (SCHOMBURGK, *Kew*, in THURN 166, 365, *Kew*, W; 350, 377, *Kew*; McCONNELL and J. J. QUELCH 576, 584, *Kew*, ULE 8515, B); Cucuya Creek (APPUN 1005, *Kew*), Potaro River, below and above the Kaieteur (JENMAN 1422, *Kew*); Macreba Falls (GELSON 365).

French Guiana s. l. (LEPRIEUR, *Kew*).

Brazil: Amazon Valley, Rio Uaupés near Panuré (SPRUCE 2452, *H*, *Kew*, W); some tufts typical, others (in *H*) with all fronds simple and scarcely distinguishable from *C. graminoides* with interrupted sori. — Para? (GLAZIOU 12368, B, *H*, W).

?Jamaica s. l. (JENMAN, W). — These specimens come very near to SWARTZ' type of *C. graminoides* and may be a form of it with interrupted sori.

4. *Cochlidium minus* (Jenm.) Maxon, Pteridophyta of Porto Rico 407. 1926. — Plate I fig. 2, III fig. 2.  
*Monogramme minor* Jenman, Bull. Bot. Dept. Jamaica II. 4: 212. 1897.  
 C. Chr. Index.

Type from Jamaica, leg. JENMAN (*Kew!*).

This small species is certainly closely related to *C. graminoides*, from which it differs by the brighter and somewhat thinner scales, by the broader leaves, which are 2—8 cm. long, 1—2 mm. wide, rarely distinctly dilated at the apical portion and rarely forked, the margins mostly sinuate, the veins simple, much longer than in the other species and without distinct hydathodes. Sori confined to the apical third or half, superficial, early confluent and nearly covering the flat unaltered blade, rarely discontinuous and polypodioid.

The above characters, which are partly copied from MAXON's excellent description (l. c.), are the essential ones for the specimens from Jamaica and Porto Rico, while those from Cuba somewhat approach *C. graminoides* by the apical fertile portion of the blade being often somewhat dilated and concave. As mentioned before, these specimens may at least possibly belong to *C. graminoides*; on the other hand some specimens from Porto Rico differ from *C. seminudum* by their small size only.

Porto Rico, on trees in the mountains (J. A. SHAFER 2245, 3647, W. E. HESS 313, E. G. and N. L. BRITTON 7917, HIORAM 335), all *W.*).  
Jamaica: Murray's Flat above Mt. Moses (JENMAN, *Kew*).  
Cuba: Prov. of Santiago (POLLARD and PALMER 240); Oriente: Sierra Nipe (SHAFER 3473, 3475, 4110), Sierra Moa (SHAFER 8072, 8159) all *W.*

5. *Cochlidium seminudum* (Willd.) Maxon, Pteridophyta of Porto Rico: 407. 1926. — Plate I fig. 3.

*Blechnum seminudum* Willd. Phytogr. 13 pl. 8 fig. 2. 1794.

*Monogramme seminuda* Bak.; C. Chr. Index 431 with synonymy.

*Pleurogramme nuda* Goebel, Flora 117: 119. 1924; with several figures.

Type from Martinique, leg. ISERT 1787 (*B.*, cotype-specimens in *H.*).

The locality: Guinea quoted by WILLDENOW, KAULFUSS (*Taenitis pumila* Enum. 132) and others is false. The collector PAUL ERDMANN ISERT (1756—1789) was a German surgeon who in 1783 was appointed to the Danish Colonies on the Guinea-coast, where he gathered a fair number of plants. During his return to Europe in 1787 he paid a short visit to the island of Martinique in the West-Indies, and there too he collected some plants. His herbarium was delivered to Professor ERIK VIBORG in Copenhagen and is now in the Botanical Museum of Copenhagen; several duplicates were sent to other botanists, f. inst. WILLDENOW in Berlin. In our Museum are found beautiful specimens of *C. seminudum* with the original label: "I. Martinique 87". Another specimen with a label of later date is said to be "I. Guinea", but is evidently a part of the type-collection from Martinique; it is *Taenitis pumila* Klf. and *Grammitis Iserti* Sw., which are thus direct synonyms of *C. seminudum*.

*C. seminudum* is excellently described by MAXON and GOEBEL l. c. The latter writer, who erroneously used the name *seminuda* for a related Brazilian species and therefore created a new name, *Pl. nuda*, for the genuine *C. seminudum*, has examined it morphologically and anatomically. Referring the reader to his paper I give only the most important morphological characters of the species here.

Fronds 8—20 cm. long. 2—5 mm. broad at the middle, attenuate both ways, normally flat with thin plane entire margins, often forked. Midrib distinct and somewhat raised on both sides from base to apex; veins of the sterile portion of the fertile leaf very oblique, terminating within the margin in a small hydathode, usually simple — some forked veins are not rarely met with in larger fronds — and free, seldom united near the margin and forming oblique areoles as in *Vittaria*. Sori superficial, close to the midrib in the upper half of the blade, often borne on anastomosing veins parallel to the midrib, narrow and not covering the whole surface.

The geographical range of *C. seminudum* is rather limited. Its centre is the chain of the Lesser Antilles and Porto Rico, west and south of which it becomes very rare.

[Jamaica, t. MAXON; no specimen seen].

Sto Domingo: Laguna (ABBOTT 436, *W.*).

- Porto Rico, not rare in the mountains; about a dozen specimens seen. St. Kitts (BREUTEL, *B*, BRITTON and COWELL 684, *W*, RYAN, *H*).  
 Montserrat (J. A. SHAFER 280, 795).  
 Guadeloupe (L'HERMINIER 3, 40, PERROTET, DUCHASSAING, MAZÉ 323 and others).  
 Dominica (SIEBER Syn. Fil. 151, IMRAY, D. MORRIS, EGGERS 933 and ed. TOEPFFER 665).  
 Martinique (ISERT, BELANGER, L. HAHN 58, 583, 1417, PÈRE DUSS 1557, HUSNOT 298 and others).  
 St. Lucia (H. B. MURRAY).  
 St. Vincent (EGGERS 6857).  
 Grenada (GUILDING, SHERRING 96, MURRAY and ELLIOTT 12, G. S. MILLER s. n.).  
 Trinidad (CRÜGER 121, *B*, Bot. Gard. Trinidad 1259).  
 Guiana (French) (RICHARD, LEPRIEUR).  
 Venezuela: Island of Margarita (J. R. JOHNSTON 186).

6. *Cochlidium paucinervatum* (Fée) C. Chr. comb. nov.

*Grammitis paucinervata* Fée, Cr. vasc. Brésil 2: 51 pl. 96, fig. 1. 1873.

*Polypodium paucinervatum* C. Chr. Ind. 551.

*Monogramma Rudolfi* Rosenst. Festschr. Alb. v. Bamberg 63. 1905; C. Chr. Ind. 431.

*Monogramme seminuda* Bak. Fl. bras. 12: 547, et auctt. quoad specim. brasil.

*Pleurogramme seminuda* Goebel, Flora 117: 119, fig. 10. 1924.

?*Grammitis punctata* Raddi, Pl. Bras. 1: 11 pl. 22 bis.

*Polypodium ?punctatum* Hook. sp. 4: 172. 1862. fig. 1. 1825.

Type from the mountains of Rio de Janeiro, Brazil, GLAZIOU 5384 (*B*, *H*).

This species was founded by FÉE upon dwarfy and poorly fertile specimens which are certainly not specifically different from the larger form described as *Mon. Rudolfi* Rosenst.; several of the individuals of the type-collection of *M. Rudolfi* are also identical in size with the type-specimens of *Gr. paucinervata*. The rather numerous specimens from Southern Brazil examined by me are so alike as to most important characters that I refer them all to one species, for which I use the oldest sure specific name. In Fil. Afr. 59 KUHN quoted *Grammitis punctata* Raddi as a synonym of his *Taenitis seminuda*, and it is highly probable that he was right in doing so, as his species also includes the Brazilian species. As to some points RADDI's description and figure do not agree perfectly with *C. paucinervatum*, and I therefore prefer not to use RADDI's specific name although it is fully available and although I believe that his species is identical with *Gr. paucinervata*.

The present species has been elaborately dealt with by GOEBEL (l. c.) under the wrong name *Pl. seminuda*, and he has shown clearly how it differs from the true *C. seminudum* (l. c. p. 119), with which it was united by most authors. Its most important characters are:

Scales of rhizome longer than in *C. seminudum*, long acuminate, nearly hair-pointed; fronds 1 to 10 cm. long, 1 to 3 mm. wide, obtuse or subacute; midrib faintly raised above, often fully hidden beneath and covered with parenchyma, the veins of the sterile parts furcate, in small fronds sometimes simple, terminating in large hydathodes; the upper fertile portion as a rule conduplicate. Sporangia borne on the basal part of the fertile veins which run parallel to the midrib (see GOEBEL's fig. 10. II) but do not anastomose as in *C. seminudum*. Sori superficial, confluent and at maturity cover the whole nether surface, much broader than in *C. seminudum*, with which the species otherwise agrees closely. For other differences see GOEBEL l. c. p. 119.

*C. paucinervatum* is distributed through the southeastern states of Brazil; I enumerate some collector-numbers:

Rio de Janeiro (GLAZIOU 1738, 2385, 5384, 5648, BURCHELL 2300, H. SCHENCK 1431, 2572, MENDONÇA 427, 1143, DUSÉN 1102, 150, 154, RIEDEL and several others).

Minas Geraes (CLAUSSEN, GARDNER 5286, MOURA 52, WARMING).

Sta Catharina (R. SCHMALZ ed. ROSENSTOCK: Fil. austrobras. exs. 73 = *M. Rudolphi* Ros.).

Paraná: Monte Alegre (DUSÉN 14174).

7. *Cochlidium linearifolium* (Desv.) Maxon in sched., comb. nov. — Plate I fig. 4.

*Monogramme linearifolia* Desv. Berl. Mag. 5: 302 pl. 7 fig. 5. 1811;

C. Chr. Ind. 430 with synonyms.

*Pleurogramme immersa* Fée, 3. mém. 57 pl. 4 fig. 5. 1852.

Type from French Guiana (not seen).

Not unlike *C. seminudum* in general habit and size, the leaves mostly distinctly linear in outline, 7—15 cm. long by 2 mm. wide, acute, flat and straight, rarely conduplicate and curved; midrib prominent above, flat beneath, the veins immersed, simple or in large forms furcate, straight, parallel and terminating in distinct hydathodes well within the margins. Coenosori often confined to the middle portion of the frond, sometimes reaching to short of the tip, distinctly immersed in a single central groove, the edges of which are somewhat produced and conceal the young sori.

Guiana (LEPRIEUR 104, APPUN 65, R. BENOIST 394, FOCKE 622 and several others).

Venezuela: Tovar (FENDLER 355, B, W).

Colombia: Buenaventura (LEHMANN 7 B, 331 W, KILLIP 11723 W).

Cuba orient. Mt. Libanon (LINDEN 2202 W).

Haiti: Marmelade (EKMAN 8211, S).

Guadeloupe: Macouba (MAZÉ 858, Kew).

8. *Cochlidium rostratum* (Hook.) Maxon in sched. comb. nov. — Plate I fig. 5—6.

*Monogramme rostrata* Hook. sp. fil. 5: 122 pl. 288 B, 1864; C. Chr. Ind. 431.

*Pleurogramme gyroflexa* Christ in Pittier: Prim. Fl. Costar. 3: 10. 1901.  
*Monogramma gyroflexa* C. Chr. Ind. 430.

Type from Nicaragua (C. WRIGHT, *Kew!*).

Very closely related to *C. linearifolium* and hardly specifically different. It differs chiefly by the following characters: rhizome mostly longer, often with rather long scaly branches, the leaves variable in size, 0.5—3 mm. wide, the upper portion early curling and forming a half-circle, conduplicate, seldom flat. Veins simple, ascending and then curved, upwards terminating in the parenchyma without distinct hydathode, in larger forms often forked (Plate I fig. 6). Coenosori confined to the apical half of the frond, not reaching the tip, immersed as in *C. linearifolium*.

The rather different forms referred to this species are all in most important characters so like *C. linearifolium* that I at first considered them forms of that species, and very likely they are so. The different habit is due to characters (curling and conduplication) which are not stable ones but probably depend on age and season, the older specimens being hard, blackish green and much curved with the sporangia shed out from the groove and apparently not immersed; *Pleurogr. gyroflexa* Christ. is such a form. The growing-place is also of importance; plants growing among high mosses become very slender with the lower portion of the leaves reduced nearly to the strong midrib. This form is *M. rostrata* Hook.; the other character by which it should be marked, the long beak-like sterile apex, is by no means constant, although most frequently found in the narrow-leaved forms. Between *M. rostrata* and *Pl. gyroflexa* all intermediates are found and I have no doubt that *P. gyroflexa* is a large-grown *rostrata*. The best character of the species, as here delimited, is perhaps found in the venation, which differs from that of *C. linearifolium* as pointed out in the descriptions of the two species. Because of this difference I have preferred to segregate the Central-American form from *C. linearifolium* as a species. The following specimens, nearly all contained in U. S. National Herbarium, belong here.

Guatemala: Chilasco (SALVIN and GODMAN, *Kew*), Cubilquitz (v. TÜRCKHEIM II 826 and ed. by DONNELL SMITH 8372), between Senahú and Actalá (MAXON and HAY 3317), between Chamá and Cobán (HARRY JOHNSON 357, 373).

Nicaragua: Omotepee (C. WRIGHT, *Kew*, W, Le).

Gosta Rica: s. l. (WERCKLÉ 221, RB = "*Pleurogramme gyroflexa* Christ. n. sp.", but not the type); La Palma (MAXON and HARVEY 7887, 7945, 7949, 7950, 7977, STANDLEY 38337), in different localities north of San Isidro, Prov. de Heredia, 2000—2400 m. (STANDLEY and VALERIO 49123, 50016, 50329, 51570, 52379); Zurquí (STANDLEY 48049, 48343); La Carpintera (STANDLEY 34408, 35605, R. TORRES 113); Sta. Clara de Cartago (MAXON and HARVEY 8143, C. H. LANCASTER 659); Alto de La Estrella (STANDLEY 39067, 39128), near Orosi (STANDLEY 39690); San Jerónimo (WERCKLÉ, Herb. Jiménez 552, 568), Tablazo (A. et C. BRADE, ed. ROSENST. no. 57); Volcan

Barba (VALERIO 128), Prov. de Alajuela (STANDLEY and TORRES 47486, 47799) — s. l. (ENDRES 88, *Wi*).

Panamá: Chiriqui (MAXON 5514, Mrs. CORNMANN 1026, 1108, 1236).

var. *areolatum* n. var. — Plate I fig. 7.

In habit not different from the form described as *Pleurogramme gyroflexa* but the veins usually anastomosing, forming large, oblique costular areoles.

Haiti: Morne Colombeau, Anse-à-Foleur (EKMAN *H* 4367, type *CC*).

Cuba: Oriente (C. WRIGHT 866, *W*); Sierra Maestra, El Cobre (Frère

CLÉMENT 1407 *CC*, LÉON and CLÉMENT 10468).

Jamaica s. l. (HART 220 *W*).

### *Dubious species.*

*Pleurogramme myrtillifolia* Fée, 3. mém. 58, 5. mém. pl. 10 C. 1852.

*Monogramme myrtillifolia* Hook. sp. 5: 125. 1864; C. Chr. Index.

This Mexican(?) species seems to be unknown to all later authors; by its wide-creeping rhizome it is very different from all species of *Cochlidium*.

## 2. *Scleroglossum* v. A. v. R.

Bull. Jard. Bot. Buitenzorg. II sér. no. VII. 37, pl. V. 1912; Handb. Suppl. 339.

*Vittaria* and *Pleurogramme* spp. auctt.

Differs from *Cochlidium*, which it resembles perfectly in general habit, rhizome, scales and shape and texture of the leaves, by the following characters. Surfaces and margins of leaves furnished with scattered minute, stellate brown hairs, which are very deciduous and often not found in dried specimens, but probably they occur in fresh young leaves of all species. Veins deeply sunk in the tissue, simple or more commonly furcate or irregularly branched, the branches sometimes anastomosing. Coenosori confined to the apical portion of the lamina, mostly medial between the edge and the midrib, which is hidden in a costal parenchyma between the two sori, never close to the midrib as in *Cochlidium*, deeply immersed in two oblique grooves, the mouth of which opens either toward the edge or vertically and in some forms is truly marginal as in *Euvittaria*, the inner edge of the groove often somewhat produced and covering the young sori. Paraphyses none (or very few and small, consisting of 1 or 2 cells, cf. GOEBEL l. c.).

Type-species: *Vittaria pusilla* Bl.

To this genus belongs a small number of forms from Tropical Asia, Australia and Polynesia, which certainly resemble the species of *Cochlidium* so closely that it would be quite natural to reduce *Scleroglossum* to a group of the American genus, but on the other side such important characters as the occurrence of stellate hairs, more complicated venation of the larger forms, the different position of the deeply immersed coenosori, together with an other geographical area, justify its segregation.

VAN ROSENBURGH referred to *Scleroglossum* four species, one of which does not belong here (*S. pyxidatum*), and COPELAND has described two more; to these five species two others (*Vittaria crassifolia* and *V. wooroonooran*) must be added. I have examined all of them but must confess that I am not able to distinguish them with certainty. They are all rarely collected and the material in most herbaria is very poor, so it is difficult to state with certainty if the characters ascribed to the species hold good. My arrangement of the forms must, therefore, be regarded as an essay, with which I am not myself satisfied.

#### Key to the Species.

1. Mouth of soral groove distinctly intramarginal ..... 2  
    — — marginal ..... 5
2. Leaf-edge outside the groove attenuate towards the margin ..... 3  
    — — thick, angular or round ..... 4
3. Small (2—3 cm.  $\times$  1—2 mm.); most veins simple; leaf-edge outside the groove about as broad as the costal parenchyma (cf. *S. pusillum* var. *angustissimum*) ..... 1 *S. debile*  
    Larger (5—10 cm.  $\times$  3—4 mm.); veins branched; sori intramarginal; leaf-edge at best half as broad as the costal parenchyma ..... 2 *S. pusillum*
4. Larger; leaves linear (5—15 cm.  $\times$  3—4 mm. acute); leaf-edge outside the sorus angular ..... 3 *S. sulcatum*  
    Smaller, leaves spatulate, 2—3 cm.  $\times$  3—4 mm., broadly obtuse; leaf-edge round ..... 4 *S. wooroonooran*
5. Small, 5—10 cm.  $\times$  1—3 mm. .... 5 *S. minus*  
    Large, 10—20 cm.  $\times$  4—8 mm. .... 6 *S. crassifolium*.

1. *Scleroglossum debile* (Kuhn) v. A. v. R. l. c. 39. — Plate II fig. 1, IV fig. 1.

*Vittaria debilis* Kuhn, *Linnaea* 36: 67. 1869.

*Vittaria minor*  $\beta$  *minima* Hooker, spec. 5: 183. 1864.

Type from Sarawak, THOS. LOBB (*B!*)

The smallest form, leaves 3—4 cm. long, 1—2 mm. broad, often very numerous in dense tufts; thinly coriaceous veins mostly simple, not running beyond the sorus-groove; this not deep, intramarginal, the edges of the lamina beyond as a rule broader than the costal parenchyma, thin and attenuate, often sinuous; sori often very short.

This may be a small form of *S. pusillum*; the difference in the position of the sori is small only and the simpler venation stands in correlation to the narrowness of the leaves.

Borneo: Sarawak (LOBB, *B*), Kuching (Nat. Collector of Sarawak Mus. 42, CC), Mt. Matang (Hose 153 pp. *Kew*), Mt. Santubong (Brooks, *Kew*).

Malay Peninsula: Johore, Gun. Panti (RIDLEY, HOLTUM 17493, *Si*), Gun. Pulau (RIDLEY), Malacca (RIDLEY 3353, *Si*), Pahang, Gun. Kajang (HENDERSON 18275 A, *Si*), Penang (HOLTUM s. n., RIDLEY s. n. *Si*).

New Guinea: Papua, Kari Mts. (SCHLECHTER 17198, *B*, *RB*).

2. *Scleroglossum pusillum* (Bl.) v. A. v. R. l. c. pl. V fig. 1, 2. Handb. Suppl. 340 pro parte. — Plate II fig. 2—3.

*Vittaria pusilla* Bl. Enum. 199. 1828.

*Taenitis pusilla* Mett. Ann. Mus. Lugd. Bat. 4: 172 pl. 4 fig. 11—14, 1869; with full description.

*Pleurogramme pusilla* Christ, Philipp. Journ. Sci. 2 C: 175. 1907.

*Vittaria falcata* Kunze, Bot. Zeit. 1848: 198, Fée, 3. mém. 23, pl. 4 fig. 2. 1852.

*Taenitis simplicivenia* Cesati, Rendic. Acad. Napoli 16: 30. 1877.

*Monogramma intermedia* Copel. Philipp. Journ. Sci. 1 Suppl. 255. 1906.

*Pleurogramme intermedia* Copel. in ELMER'S Leaflets 2: 408. 1908.

Type from Java: Mt. Gedé I. BLUME (n. v.).

Leaves subcoriaceous to coriaceous, 5—10 cm. long, 2—4 mm. broad, rarely larger, acutish or obtuse, often sinuate; veins mostly forked or irregularly branching sometimes anastomosing, protruding beyond the sori; marginal, stellate hairs often present in dried specimens. Coenosori in the apical third, rarely half of the blade, distinctly inframedial, the inner edge of the groove usually acute and somewhat produced over the sori, the outer attenuate toward the margin and generally half as broad as the costal parenchyma, the mouth of the groove opening toward the margin.

To this species I refer specimens only which agree with those from Java, but it should probably be taken in a wider sense, including *S. debile* and *S. sulcatum*, which see. The former is very likely only a small form of *S. pusillum*, as intermediates between the two types are not rare. Such intermediate forms are *Taenitis simplicivenia* Ces. and *Monogramma intermedia* Cop., which are very nearly identical, both differing a little from typical *S. pusillum* by the leaf-edge outside the sori being broader and often with a raised rim along the groove. The specimens seen are smaller than the type but larger than *S. debile*.

Java: Mt. Salak (GOEBEL, RACIBORSKI), Pasir Karit (BAKHUIZEN 4514). Sumatra: Pea Radja, Batakerland (WINKLER ed. ROSENSTOCK, Fil. sumatr. exs. 167 as *Vittaria sulcata* B, SB).

Borneo: Mt. Kinabalu (MRS. CLEMENS 10722, BSci), G. Sakoembang (KORTHALS, L), G. Klam (HALLIER 2387, L), Amai Ambit (HALLIER 3172, L), W. Koetai: Kemoel (ENDERT 4272, Bog).

Malay Peninsula: Johore (HOLTUM 10646), Mt. Ophir (RIDLEY 3352, 9864, 9865), Penang (RIDLEY 15978), Pahang (WRAY and ROBINSON 5301, BURKILL and HOLTUM 8461, NUR 11267, ERYL SMITH 906), Perak (SCORTECHINI), Kedah (HANIFF and NUR 7914, HANIFF 602, RIDLEY), Selangor (RIDLEY) (all in Si).

Siam: Gunong Ina (KERR 7595, Kew).

Annam: Massif de Bah-Na (Dr. SALLET, P).

Hainan: Five Finger Mt. (ERYL SMITH 1410 W, McCLURE 8691 Cal).

Philippine Isl. Negros: Mt. Silay (WHITFORD 1503 W, type of *M. intermedia* Cop.).

New Guinea: Mt. Arfak (BECCARI, Kew, type of *Taen. simplicivenia* Cec.), Papua, (L. SCHULTZE 316, LEDERMANN 8438, 9137, 12739<sup>a, b</sup>, all B).

- var. *angustissimum* (Copel.) C. Chr. comb. nov. — Plate II fig. 4, IV, fig. 2.  
*Scleroglossum angustissimum* Copel. Philipp. Journ. Sci. 12 C: 65. 1917.  
*Scl. pusillum* var. *novoguineense* v. A. v. R. Hdb. Suppl. 1: 340 (an *Pleurogramme Loheriana* var. *novoguineensis* Rosenst. Nova Guinea 8: 729?).

Fronds linear-spatulate, 2—5 cm. long, the long sterile lower portion linear, 0.5—1 mm. broad, nearly reduced to the strong midrib, the much shorter (0.5—1.5 cm. long) apical fertile portion rather abruptly dilated, 1—2 mm. wide, coenosori as in the type.

Borneo: Mt. Kinabalu (Mrs. CLEMENS 11048, type *BSci*); W. Koetai: Kemoel 12—1700 m. (ENDERT 3586, 4547, *Bog*).  
 New Guinea: Doormantop (H. J. LAM 1488, *Bog*).

This variety is, I think, only a very slender form of *S. pusillum* growing among high mosses; in *Cochlidium* we find corresponding narrow forms (see *C. rostratum*). VAN ROSENBURGH identified the specimen from New Guinea with a variety described by ROSENSTOCK and perhaps rightly, though it is said to have sori 1.5 mm. long only, thus agreeing better with *S. debile*.

3. *Scleroglossum sulcatum* (Kuhn) v. A. v. R. l. c. pl. 5 fig. 3—4 — Plate II fig. 5.

*Vittaria sulcata* Kuhn, Linnaea 36: 68. 1869.

*Taeniopsis mauruensis* Nadeaud, Journ. de Bot. 13: 8. 1899.

*Vittaria mauruensis* C. Chr. Ind.

Type from Ceylon, THWAITES 3807 (*B! Kew! Le, Wi*).

Very closely resembling *S. pusillum*, differing by the lamina outside the sori being thickened and angular in cross-section, with a low rim along the outer edge of the groove and the inner edge not produced, the mouth of the groove therefore vertical. This is the only character ascribed to it by KUHN and v. A. v. R. and illustrated by the latter author, by which it may be distinguished from *S. pusillum*, but I fear that is not a good one; some of the specimens referred above to *S. pusillum* var. *intermedium* are scarcely different and old leaves of tufts of typical *S. pusillum* often show very nearly the same character. As all specimens from Ceylon examined, about half a dozen, are very similar I dare not now reduce *S. sulcatum* to a form of *S. pusillum*.

*S. sulcatum* is said by v. A. v. R. to be distributed "from Ceylon to Polynesia"; it is probable that he refers forms here named *S. pusillum* var. *intermedium* to this species. KUHN with doubt referred to it a fragmentary specimen from Tahiti which no doubt is the same as *Taeniopsis mauruensis* Nad., and after examination of some few specimens from Polynesia I must confess that I cannot distinguish them from the Ceylonese type. It is surprising that the same species should occur at the extreme boundaries of the area inhabited by the genus, being rare or lacking in the immense regions between but superseded there by related forms. It is much more natural to suppose that *S. sulcatum* is a form of *S. pusillum* occurring here and there.

Besides some specimens from Ceylon I refer here the following specimens:—

Malay Peninsula: Penang (RIDLEY s. n., *RB*), Perak (RIDLEY s. n., *Si*), Pahang (RIDLEY 13952, *Si*).

Borneo: Mt. Kinabalu (HAVILAND 1481, *Kew*, Mrs. CLEMENS 10722, *BSci*).

New Guinea: Koebié Mt., Dutch N. W. New Guinea (L. S. GIBBS 5729, *RB*).

Caroline Isl.: Ponape (LEDERMANN 13393, *B*).

Samoa: Upolu (REINECKE 117, *RB*, 117a *B*, 126a *B*; E. BETCHE 106, *RB*), Savaii (REINECKE, *B*).

Tahiti (LEPINE, *B*).

4. *Scleroglossum wooroonooran* (Bailey) C. Chr. comb. nov. — Plate II fig. 6, IV fig. 3.

*Vittaria wooroonooran* Bailey, Report Govt. Sci. Exp. Bellenden-KER 77. 1889; Syn. Queensl. Fl. Suppl. III, 91. 1890; Lithogr. pl. 50 fig. B.

*Vittaria pusilla* var. *wooroonooran* Domin, Bibl. Bot. 85: 164 pl. VII fig. 1 (excellent).

Type from Queensland: Bellenden-Ker Range, 4000—5000 ft. (BAILEY, cotype, *Kew*! SAYER, L. S. GIBBS 6325, *Kew*, DIELS 8550, *B*).

Differs from *S. sulcatum* chiefly by the shape of the leaves; they are spatulate-ligulate, without stipe, 2—3 cm. long, 3—4 mm. broad, broadly rounded or almost truncate at the apex, gradually narrowed from the middle toward the base. Sori intramarginal in the apical broader portion of the blade, extending nearly to the tip; outer edge of the groove thick, in cross-section about round, the inner a little produced, the mouth therefore opening toward the margin.

A very characteristic and constant species, known from the type-locality only.

5. *Scleroglossum minus* (Fée) C. Chr. — Plate II fig. 7.

*Vittaria minor* Fée, 3. mém. 23 pl. 4 fig. 2. 1852.

*Pleurogramme minor* Copeland, Philipp. Journ. Sci. 7 C: 53. 1912.

*Pleurogramme Loheriana* Christ, Bull. L'Herb. Boiss. II. 6: 1006. 1906; Philipp. Journ. Sci. 2 C: 175. 1907.

*Monogramma Loheriana* v. A. v. R. Handb. Mal. F. 553. 1908.

Type from Luzon, Cuming no. 381 pp. (n. v.).

Leaves very thick, coriaceous, 5—10 cm. long, 1—3 mm. wide, sometimes furcate; sori usually short, confined to the upper fourth of the lamina, which terminates in a short rounded or subacute sterile tip; mouth of the deep soral grooves marginal, its outer edge not or very slightly produced beyond the sori, attenuate.

Most authors have united this species with *S. pusillum*, but if I interpret that species rightly *S. minus* seems to be safely distinct by its thicker leaves and marginal sori. I agree with COPELAND in identifying FÉE's

type with *Pl. Loheriana* Christ; FÉE illustrates a rather small form of the species, and his specific name, appropriate in *Vittaria*, is a bad one in *Scleroglossum*, because the species is not smaller than *S. pusillum*. The curious stellate hairs often seen in *S. pusillum* are rarely observed in *S. minus*, but probably they occur normally in young fresh leaves.

Philippine Islands (most specimens in *W*): Luzon: Mt. Mariveles (COPELAND 78, WHITFORD 127), Mt. Santo Tomas (R. S. WILLIAMS 1563 = *f. furcata*), Pauai (Bur. Sci. 8741, 31875), Mt. Maquiling (Mt. Maquiling, COPELAND 2031, *B*, ELMER 17690, MATTHEW), Lucban, Tayabas (ELMER 7765, *Le*), Paningtingan (ELMER 13491), Mt. Pulog (Bur. Sci. 44803), Rizal Prov. (LOHER 14218), Mt. Data (COPELAND 1883, *B*).

— Mindoro: Mt. Halcon (MERRILL 5855).

— Palawan: Mt. Capoa (MERRILL 9766).

— Panay: Mt. Bulilao (Bur. Sci. 35734).

— Negros: Canlaon Volcano (MERRILL 608), Dumaguete, Cuernos Mts. (ELMER 10086).

— Mindanao: Mt. Apo (ELMER 11688, *B, W*).

Amboina: Salahoetoe (ROBINSON 1965, *W*).

6. *Scleroglossum crassifolium* (Baker) C. Chr. Gardens Bull. Singapore 4: 407, 1929. — Plate II fig. 8.

*Vittaria crassifolia* Baker, Kew Bull. 1893: 212.

Type from Sarawak: Mt. Dulit, HOSE 306 (*Kew?*).

The largest form of the genus, the leaves up to 20 cm. long, 5—8 mm. wide, still generally smaller, thinly coriaceous to coriaceous, the upper half fertile, linear and generally narrower than the lower sterile half. Mouth of sorol groove marginal, just as in *S. minus*.

This is probably a large variety or form of *S. minus*, differing from it only by its large size and long sori. The type-specimen at Kew is the largest seen, its leaves nearly one cm. broad.

Borneo: Sarawak, Mt. Dulit (HOSE 306, *Kew*), Mt. Poi and Mt. Murud (MjöBERG, CC); Mt. Poi (FOXWORTHY 220, *BSci*).

Malay Peninsula: Selangor (RIDLEY, *Si*).

#### Dubious genus and species.

*Oreogrammitis Clemensiae* Copeland, Philipp. Journ. Sci. 12 C: 64. 1917. — Plate III fig. 7.

Type from British North Borneo: Mt. Kinabalu (Mrs. CLEMENS 10618 p.p., Bur. Sci., Herb. Copeland).

This is certainly a remarkable fern but the scanty material does not permit a detailed examination of it and I cannot therefore form a definite idea of its systematic position. COPELAND's description is excellent and I have nothing to add. The scales are like those of *Scleroglossum* but are not hidden between the leaves, but otherwise it seems very different from that genus, *f. inst.* by the filiform long stipes, the presence of long brown hairs along the edges and by the superficial sori.

In some leaves the sori are almost polypodioid but in others true linear coenosori on somewhat raised receptacles very near the midrib. Scarcely one of these characters seems sufficient to segregate the species from *Polypodium* sect. *Grammitis*, and I should prefer to drop the genus and place the species in *Polypodium*.

### **Nematopteris** v. A. v. R.

Bull. Jard. Buitenzorg II ser. no. XXVIII: 65. 1918.

Like *Scleroglossum* in mode of growth, scales and the hard fronds, differing by the very numerous, terete or angular, rush-like leaves, the fertile ones with an apical widened fertile portion. Veins nearly obsolete without sclerenchyma. Sporangia borne in deep vertical grooves on both sides of the midrib, continuous or interrupted.

Type-species: *Scleroglossum pyxidatum* v. A. v. R.

To this genus I refer two highly remarkable species, which are rather different from each other and perhaps belong to two distinct genera.

#### 1. **Nematopteris pyxidata** v. A. v. R. l. c.

*Scleroglossum pyxidatum* v. A. v. R. l. c. no. XVI: 37 pl. 9. 1914. — Plate IV fig. 4—7.

Type from Dutch Borneo: Bukit Batuayah, l. Jaheri no. 1647, Exp. Nieuwenhuis 1897 (*Bog*).

Excellently illustrated by van ROSENBURGH. The very slender, thread-fine leaves are semiterete, sulcate above, the midrib strong, sclerenchymatic, the veins apparently fully obsolete, but in reality present but without sclerenchyma and therefore scarcely visible (best seen in cross-sections) in the soaked leaf. Apical portion of the blade rather suddenly widened and fertile, beak-like, conduplicate, curved, terminating in an upcurved sterile, acute rostrum. Coenosori about 1 cm. long, immersed, the grooves opening toward the edge very much as in *Scleroglossum debile*, separated by a costal parenchyma less than 0.5 mm. broad. Sporangia glabrous; paraphyses none.

This is certainly a very distinct species, in habit resembling the type of *Cochlidium rostratum*, but it is not certain that it is generically different from *Scleroglossum*.

#### 2. **Nematopteris interrupta** (Bak.) C. Chr. comb. nov. — Plate IV fig. 8-12.

*Monogramme interrupta* Baker, Ann. of Bot. 5: 482. 1891; C. Chr. Ind. 430. *Pleurogramme interrupta* Christ, Farnkr. d. Erde 55. 1897. (Specimens named by CHRIST do not belong here).

*Polypodium pyxidiforme* v. A. v. R. Bull. Jard. Buitenzorg II ser. 1: 29. 1911, Nova Guinea 14<sup>1</sup>: 44 pl. I C. 1924.

Type from New Guinea: Mt. Yule (F. v. MÜLLER, *Kew*!).

In general habit, size and structure very similar to the former species, from which it differs materially by the nearly fully terete or triangular thicker fronds and by the sori being immersed in deep pits, which are

separated by high cross-walls and outside confined by the recurved edges, and by the sporangia being furnished by 1—3 curved, cylindrical, septate strong setæ, figured by v. A. v. R. l. c. but not mentioned in his description. — The apical widened fertile portion varies in length from 0.5 to 3 cm., the number of grooves in each side from 2 to 10; most sori are oblong; the sterile tip is sometimes rostrate as in the former species, sometimes short and obtuse.

New Guinea: Papua: Mt. Yule (F. v. MÜLLER, *Kew*); Dutch New Guinea: Doormantop (H. J. LAM 1965, *Bog*), Goliathberg (DE KOCK 45, *Bog*, type of *Pol. pyxidiforme* v. A. v. R.).

A peculiar species, well figured by v. A. v. R., the relationship of which is doubtful. Because of its close resemblance to *N. pyxidata* in general habit and structure I place it in this genus, but it is scarcely closely related to it.

### Phylogeny and Relationship of the Cochliidiinae.

As pointed out above (p. 14), all older species of this group have been referred partly to *Monogramma* partly to *Vittaria*, and it was proved there that it cannot naturally be associated with the *Vittariæ*. Its alliance with *Taenitis*, to which METTENIUS referred the species known to him, is still more remote, and the genera belong to another subfamily than *Taenitis*, which CORELAND, perhaps rightly, refers to the *Pterideae*.

All things considered it can scarcely be doubted that the *Cochliidiinae* belong to the *Polypodiæ*. In several important characters they agree with the old genus *Grammitis*, which is characterized by simple fronds and more or less elongated exindusiate sori and now reduced to a section of the subgenus *Eupolypodium*; their resemblance to some species of *Grammitis* is in reality so pronounced that it is difficult to say where the boundary between them and *Grammitis* should be drawn. In his paper on *Pleurogramme*, often referred to, GOEBEL arrived at the same result concerning the relationship of these ferns. He found the American species (*Cochlidium*) agreeing in several characters especially with *Xiphopteris* and *Adenophorus*, both groups of *Eupolypodium*, the former often made a specialized group of *Grammitis*. In my opinion *Adenophorus*, a small group of Hawaiian ferns, differs so widely from *Cochlidium* and *Scleroglossum*, that it cannot be considered as their near relative.

The other group, *Xiphopteris*, the type of which is *Polypodium serrulatum* (Sw.) Mett. is certainly very closely related to *Cochlidium*. *P. serrulatum* (*P. duale* Maxon) agrees with the smaller

species of *Cochlidium* in venation<sup>1)</sup>, scale-characters, the conduplicate apical fertile portion of the blade, position of the sori and in other characters mentioned by GOEBEL, differing chiefly by the slender elongate rhizome, the serrately lobed sterile fronds and the distinct veins. These differences are certainly too small for the segregation of *Xiphopteris* and *Cochlidium* as two genera; some of my specimens of *P. serrulatum* from Haiti (EKMAN H 4368) are very slightly sinuately toothed, about as in some specimens of *C. minus*. Considering these facts only, the only natural treatment would be to make *P. serrulatum* a species of *Cochlidium*, or at least, if maintaining the genus *Xiphopteris*, to place it among the *Cochlidiinæ*, but in that case a new difficulty arises. since MAXON has shown<sup>2)</sup> that there is nearly every gradation in form between *P. serrulatum* and several small members of *Polypodium* (section *Eupolypodium*) related to *P. trichomanoides*. If he is right it seems impossible to separate *Cochlidium* from *Polypodium*, but I am inclined to believe that *P. serrulatum* (*P. duale* Maxon) differs more from the species described by MAXON than from *Cochlidium*, but not having sufficient knowledge of these other species I find it advisable to exclude *Xiphopteris* from the *Cochlidiinæ*.

The result of these considerations is that the American genus *Cochlidium* is intimately related to certain species of *Eupolypodium*, and consequently it belongs genetically to the *Polypodiæ*, not to the *Vittariæ*. Like *Xiphopteris* it is presumably an offshoot from an older group of polypodioid ferns, in which also the ancestors of other groups of *Eupolypodium* were possibly found.

The other genus of the group, *Scleroglossum*, in its area finds no very close ally among the numerous species of *Grammitis* of the Malayan region. The problematic genus *Oreogrammitis* stands between *Scleroglossum* and *Grammitis* in its characters and COPELAND suggested that it possibly illustrates the origin of the former. I do not believe this; the only species agrees in almost all characters with *Grammitis*. It can scarcely be denied that *Scleroglossum* is nearly related to *Cochlidium*, and considering the widely different geographical distribution of the two genera it seems reasonable to conclude that, like several other pairs of plant-

<sup>1)</sup> Compare GOEBEL's fig. 10, II with MAXON's of *P. duale* Maxon, Contr. U. S. Nat. Herb. 17: 400.

<sup>2)</sup> Notes upon *Polypodium duale* and its allies. Contr. U. S. Nat. Herb. 17: 398. 1914.

genera, they are relics of an old (tertiary?) group of polypodioid ferns, which was distributed through all northern continents. During the later periods of the tertiary epoch the climate changed and became too cold or dry for most fern-species. Some species found a refuge in the higher mountains in the tropics of the Old-World, others in similar localities in the New World. Unfortunately this hypothesis cannot be proved by palaeontological finds, but it makes the close relationship of the two genera intelligible.

The type-species of *Nematopteris* is no doubt intimately related to *Scleroglossum*, while the relationship of *N. interrupta* is obscure.

### Eschatogramme Trevisan. (*Cuspidaria* Fée, *Dicranoglossum* J. Sm.).

Rhizome short-creeping with a dense mass of brown-tomentose roots, the scales minute. Leaves tufted, distinctly articulated to the rhizome, sessile (i.e. unwinged stalk none), furcately pinnatifid with few ascending long acuminate segments, furnished with few or numerous minute brown scales beneath; hairs none. Veins of the sterile portions obscure, ascending, simple or more often once or twice forked, terminating without distinct hydathode within the margin, usually free but in most forms occasionally anastomosing forming oblique areoles, or, in *E. Desrauxii*, normally forming a row of costular areoles. Sporangia of most species forming linear submarginal coenosori confined to the apical portion of the segments, borne on continuous superficial receptacles that connect the tips of the mostly simple veins; only in one species (*E. polypodioides*) are the receptacles confined to the tips of the veins, the sori therefore strictly polypodioid, rarely confluent. Paraphyses none.

*Eschatogramme* is a Tropical American genus, inhabiting a vast area from the West-Indies and Central-America to Peru and South-east Brazil. It is, however, not equally dispersed over the whole area but, as it seems, confined to certain regions, f. inst. Trinidad—Guiana—Amazonas, St. Domingo and Cuba, Honduras—Colombia, Ecuador, Peru—Bolivia, South-east Brazil.

Almost all authors have referred all forms of this genus to a single species, *E. furcata*. It must be admitted that in gross characters they are very uniform and after examination of a century of specimens I find it very natural to consider the genus monotypic. A close examination of the minute characters has revealed, however, that a number of forms may be characterized, most of which inhabit a rather restricted area and therefore must be considered distinct geographical races or varieties. Whether these forms should be dealt with as species or varieties is a matter of practical convenience. According to the practice followed in these monographical essays, I describe below the forms recognized as species.

## Key to the Species.

1. Receptacles continuous, rarely irregularly interrupted ..... 2  
   Receptacles confined to the tips of the veins, the sori round, rarely  
   confluent ..... 4 *E. polypodioides*
2. Veins of sterile parts free, once or twice forked, rarely forming  
   oblique areoles. Segments 0.5—1.5 cm. broad ..... 3  
   Veins normally forming a row of large costular areoles. Segments  
   2—5 mm. broad ..... 3 *E. Desvauxii*
3. Scales of the lower surface proportionally few (20—40 on 25 mm.<sup>2</sup>),  
   in one form nearly none, ovate-acute or lanceolate .... 1 *E. furcata*  
   Scales very small and numerous (100—150 on 25 mm.<sup>2</sup>), circular  
   with a short cusp ..... 2 *E. panamensis*

*Eschatogramme furcata* (L.) C. Chr. Bot. Tidsskr. 26: 285, 190; Index  
 319 with synonyms excl. *Taenitis Desvauxii* etc.

*Cuspidaria furcata* Fée, Gen. pl. 8 A fig. 2 (excellent).

Type-locality: The species was based by Linnæus on Plumier  
 pl. 141, which illustrates a plant gathered by Plumier in Haiti. From  
 excellent specimens gathered in that republic in the later years I give a  
 detailed description of what I consider the typical form.

The short-creeping rhizome is hidden among a dense mass of brown-  
 tomentose roots ("Wurzelschwamm", GOEBEL), the peltate scales minute,  
 blackish-brown, ovate-acute, entire, consisting of rather uniform small  
 cells, somewhat darker in the centre but without a distinct central black  
 stripe. Leaves mostly densely tufted, several together, 20—40 cm. long,  
 pinnatisect above, gradually narrowed into a winged stipe, the wings of  
 which are 3—5 mm. broad above and very gradually narrowed downwards  
 to the articulation between stipe and rhizome (unwinged stipe none).  
 Segments three or four, ascending, their midrib forming an angle with  
 the central midrib of about 35°, united by a wing to the central midrib  
 5—10 mm. broad each side, entire with even and generally flat edges, the  
 longest up to 25 cm. long, 1—2 cm. wide in the lower sterile part, the outer  
 fertile part somewhat contracted and tapering very gradually into a fine  
 apex. Texture thin-coriaceous, colour grass-green, somewhat paler or sub-  
 glaucous beneath, opaque, the upper surface naked, the under one dotted  
 with scattered minute brown, ovate-acute or ovate-cuspidate, appressed  
 scales (I count about 25 scales on an area of 25 mm.<sup>2</sup>, compare the following  
 species). Midribs black beneath almost to the tip of the segments.  
 Veins obscure, rarely faintly visible above, ascending, once or twice forked  
 and free, still occasionally united and forming oblique costular areoles,  
 not reaching the edge. Coenosori confined to the outer half or two-thirds  
 of the segment, continuous, rarely interrupted, about one mm. far from  
 the edge, which is sometimes narrowly revolute but rarely covering the  
 sori at maturity.

Sto. Domingo: Haiti (NASH et TAYLOR 1356, EKMAN H 4714), Domini-  
 can Republic (ABBOTT 1631, 1833, 1841, 1884; EKMAN H 6387).  
 Cuba: Yateras, Oriente (MAXON 4444), Las Nintas (HIORAM 2498, RB),  
 Monte Verde (WRIGHT 980, Kew).

Forms of *E. furcata*.

1. Next to the type come a couple of specimens from Northern South America, which could quite naturally be referred to *f. typica*, differing a little from it by a larger number of segments (4—6) and by the midribs of the segments being grey-brown. Number and shape of surface-scales as in the type.

Venezuela: Tovar (FENDLER 423), s. l. (FUNCK 652). — Colombia: Las Lagunas (MORITZ 144 — very near the type).

2. The East-Brazilian form, very much resembling the former, but the 4—7 (rarely 8—9) segments narrower, rarely over 1 cm wide, the surface-scales perhaps more numerous, the veins forked and free. I feel sure that this form represents a distinct geographical race but I am not able to find good characters in the material at hand by which it may be safely characterized.

Brazil: Bahia and Rio Janeiro (several collectors, f. inst. GLAZIOU 13348); Minas Geraes (DAMAZIO 1976).

3. var. *bicolor* n. var. — Differs from the type and the forms just mentioned especially by different rhizome-scales. They are more numerous, larger and in typical specimens distinctly bicolorous with a coal-black thick intransparent central stripe, that does not always extend to the tip, bordered by broad rufous, very thin edges consisting of small cells with thin walls. As to other characters this variety is very similar to the type. Leaves generally with 3—5 rarely 6 segments, seldom over 1 cm. broad, the scales of the underside in number about as in the type, much fewer and much larger than in *E. panamensis*, lance-shaped or with a long cusp; the outer fertile part of the segments is more contracted with more revolute margins than in the former varieties and very finely acuminate. Colour of midribs as in *E. panamensis*. Veins forked and free. — Seems to be a most distinct variety or perhaps species by the combination of two characters, which always occur together: 1) the black-striped rhizome-scales, and the proportionally few but rather large lance-shaped or long cuspidate scales of the underside.

Colombia: Cauca Valley (PENNELL et KILLIP 8140, type, W. 8361; LEHMANN 7385), Bogotá (KARSTEN B, TRIANA RB), Chaparral (LINDIG 210), Dept. Tolima (EUG. MAYOR 99, LEHMANN 2275), Dept. Santander (KALBREYER s. n.), Dept. Antioquia (KALBREYER 1688); Puerto Caldas (KILLIP et HAZEN 11030), Ocaña (SCHLIM 655), Rio Dagua and Portochuelo (ANDRÉ 2462, Kew).

4. var. *subnuda* n. var. — Rhizome-scales about as in var. *bicolor*, rufous and the larger ones with a narrow black central stripe. Segments long and narrow, 3—7 mm. broad, often forked, nearly naked below, most of the very few scales found near the midrib. Fertile parts much contracted with revolute margins that often cover the sori. Perhaps a distinct species.

Bolivia: Nordyungas, Polo Polo bei Coroico (BUCHTIEN 3586, type,

W, *Kew*), Mapiri (BUCHTIEN 2144, W), Ligre Pata(?) (R. S. WILLIAMS 1350, W).

Peru: La Merced (MACBRIDE 5658, W) ?(CARLOS O. SCHUNKE, RB).

***Eschatogramme panamensis* sp. nov.**

Rhizome-scales similar to those of typical *E. furcata*. Segments 6—7, seldom 8 (3—5 in smaller leaves), rarely 1 cm. wide, the edges often undulated; midrib blackish below, soon turning into brownish or greenish, those of the segments as a rule green like the leaf-tissue. Scales of the underside very small and numerous (I count 100—150 on 25 mm<sup>2</sup>), orbicular with a very short cusp. Veins of the sterile parts once or twice forked, very rarely united and forming areoles.

Type from Panamá, leg. MAXON no. 4642 (W).

Although the species here proposed as new as to certain characters (number of segments, colour of midribs) agrees with the continental forms referred to *E. furcata*, it seems to me to be a good and distinct one, especially marked by the very numerous and very small scales of the underside. As to these characters the numerous Central-American specimens seen are remarkably alike.

*E. panamensis* is distributed from Honduras to Colombia, especially common in Panamá. I quote some collector-numbers, nearly all represented in W.

Honduras: Trail to Rio Platano (PERCY WILSON 689).

Nicaragua: Mosquito Coast (F. E. SCHRAMM 13), Chontales (R. TATE 63).

Costa Rica: Not rare and often collected, f. inst. TONDUZ 9940 (= DONNELL-SMITH 7220), 14561, PITTIER 2680, STANDLEY 36907, 40209, ØRSTED 2438 (H).

Panamá: Common in the Canal Zone, especially in the forests round the Gatun Lake: MAXON 4642, 4882, 6790, 6880, KILLIP 2812, 2926, STANDLEY 27517, 28420, 29938, 31279, 40806, etc. Colon (MAXON 5773); s. l. FENDLER 387.

Colombia: Córdoba, Dagua Valley (PITTIER 566), La Mesa, Dept. Antioquia: (KALBREYER 1404, B), Llanos de San Martin (STÜBEL 641, B); s. l. (M. T. DAWE 246, *Kew*; veins partly anastomosing).

***Eschatogramme Desvauxii* (Kl.) C. Chr. comb. nov.**

*Taenitis Desvauxii* Kl. *Linnaea* 20: 431. 1847.

*Taenitis furcata* Hook. et Grev. *Ic. Fil.* pl. 7.

*Cuspidaria subpinnatifida* Fée, 3. mém. 26, Gen. pl. 8 A fig. 1.

*Dicranoglossum subpinnatifidum* Moore *Ind.* 316.

Type. The specific name *Desvauxii* was first given without description by KLOTZSCH to specimens from British Guiana, leg. SCHOMBURGH nr. 243 (B!), still the right type-specimen is, I suppose, that pictured by HOOKER and GREVILLE pl. 7, which was gathered in Trinidad by LOCKHARDT; that plate is expressly stated by KLOTZSCH to illustrate his species, not the genuine *Pteris furcata* L.

In scale-characters and number of segments scarcely different from *E. panamensis*; the scales of the underside are similarly minute and numerous, perhaps a little different by being more distinctly short-cuspidate, the midribs greenish. The main-characters of the species are the small size: segments commonly 2—5 mm. broad only, and the venation: veins of the sterile parts mostly simple, arching upwards and as a rule united with the following vein, a row of costular areoles thus being formed (v. FÉE Gen. pl. 8 A, fig. 1), those of the broader forms usually forked and sometimes forming smaller areoles outside the costular ones.

The uniformity of a large number of specimens from Trinidad and Guiana, from which those from Amazonas scarcely differ, seems to justify the segregation of this small form as a species. It is more intimately related to *E. panamensis* than to typical *E. furcata*.

[St. Vincent (Goulding) t. Hook. and GREV. Ic. Fil. pl. 8; I have seen no specimen from that island.]

Trinidad and Guiana: Common and gathered by almost all reputed collectors.

Brazil: Amazonas, Pará (SPRUCE 7, *Kew*), São Gabriel (SPRUCE 2370),

Juruá Miry (ULE 67 b), Rio Cuquenán (ULE 8522).

Bolivia: Jumapasa (C. E. WHITE 1831).

**Eschatogramme polypodioides** (Hook.) C. Chr. sp. nov.

*Taenitis furcata* var. *polypodioides* Hook. sp. 5: 188. 1864.

In most characters scarcely different from *E. panamensis*, thus in scale-structure and size and number of the scales of the underside. Number of segments 5—10, the midribs stramineous often almost to the base. Upperside with rather many minute scales like those of the underside. Veins once or rarely twice forked in the sterile parts, never forming areoles. Receptacles punctiform or oblong, confined to the tip of the often unbranched veins of the fertile parts of the segment, the sori therefore round, polypodioid, forming a row within the edge.

Type from Ecuador, at the base of the Andes on the road to Guayaquil (JAMESON, *Kew*!).

I venture to segregate this peculiar form from *E. furcata* as a species because all specimens seen from Ecuador show the same two characters, in which it differs from all other forms of the genus: the somewhat scaly upper surface and especially the round sori. In other forms the linear receptacles may be interrupted, but in this species the receptacles are normally confined to the tips of the veins and rarely two or three of these sori are confluent. The number of segments are larger than in all other forms.

Ecuador: Teresita, province Guayas (A. S. HITCHCOCK 20420, 20455, W); Ventana River (SPRUCE 5676, 6576, *Kew*, RB), Rio Yaguachi (SODIRO RB), Chimbo (HUTCHINSON 9001, *Kew*), Limon (TATE 519), Puzuelos (STÜBEL 1014, B), s. l. (FRASER, JAMESON).

The systematic position and the relationships of *Eschatogramme* are fairly clear. It no doubt belongs to the *Polypodieæ* and has the scaly underside in common with a considerable number of species of *Polypodium*, most of which were referred by DIELS to a separate genus *Lepicystis* (*Polypodium* § *Marginaria* Ind. Fil.). Some of these species have free veins, some goniophleboid and some more complicated venation. I do not, however, know any species of *Lepicystis* which can be regarded as intimately related to *Eschatogramme*, although it is probable that *Lepicystis* and *Eschatogramme* are derivatives from the same group of ancient polypodioid ferns. Another small group of *Polypodium* resembles, however, *Eschatogramme* much more; the best known species of it is *P. angustum* (H. B. W.) Liebm., the type-species of the genus *Pleopeltis* H. B. W. and widely spread through Tropical America. It differs from *Eschatogramme* chiefly by its complicated venation and polypodioid sori, being very similar in mode of growth, habit, cutting and scales. In my opinion *Eschatogramme* and *Pleopeltis* sens. propr. are sister-genera, both developed from *Lepicystis*-like ancestors. The natural position of *Eschatogramme* must consequently be between *Lepicystis* and *Pleopeltis*.

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#### The genus *Drymoglossum* as commonly delimited.

In the following list I enumerate all species of *Drymoglossum* adopted in my Index with its supplements besides a couple of new ones described since 1916.

1. *D. Brooksii* v. A. v. R. — Sumatra.
2. *D. carnosum* (Wall.) J. Sm. — China. India bor.
3. *D. cordatum* Christ. — Annam.
4. *D. crassifolium* Brause. — Papua.
5. *D. fallax* v. A. v. R. — Amboina.
6. *D. heterophyllum* (L.) C. Chr. — Tropical Asia.
7. *D. martinicense* Christ. — Martinique.
8. *D. metacoelum* v. A. v. R. — Borneo.
9. *D. microphyllum* (Pr.) C. Chr. — East Asia.
10. *D. niphoboloides* (Luer.) Bak. — Madagascar.
11. *D. novo-guineæ* Christ. — Papua.
12. *D. obovatum* (Harr.) Christ. — Formosa.
13. *D. rigidum* Hook. — Borneo.

14. *D. Schlechteri* Hieron. et Brause. — Papua.
15. *D. tetragonum* v. A. v. R. — Borneo.
16. *D. Underwoodianum* (Maxon) C. Chr. — Costa Rica.
17. *D. Wiesbaurii* Sodiro. — Ecuador.

All these species I have seen and compared in detail and the results of my studies are given below.

In two recent papers *Drymoglossum* has been dealt with. GOEBEL<sup>1)</sup> has examined *D. heterophyllum* and *D. carnosum* anatomically and morphologically and T. NAKAI<sup>2)</sup> has given a systematic review of the Asiatic species known to him. GOEBEL arrived at the result that the two species examined are so different that they should naturally be referred to two different genera: *Drymoglossum* and *Lemmaphyllum*, and he adds (p. 147): "bei *D. rigidum* scheint mir nach den Diagnosen die Zugehörigkeit zu *Drymoglossum* fraglich". NAKAI arrives essentially at the same result, yet retains all species in a single genus: *Drymoglossum*, which he divides into two sections: *Eu-Drymoglossum* and *Lemmaphyllum*, referring to the former two species: *D. rotundifolium* and *D. piloselloides*, to the latter three: *D. carnosum*, *D. microphyllum* and *D. obovatum*. The majority of the species described were unknown to NAKAI.

Referring the reader to GOEBEL's paper for details I shall here confine myself to saying that my own studies have shown that he was quite right in segregating *Lemmaphyllum* from *Drymoglossum* and in believing that *D. rigidum* is generically different from both. It is the type-species of a third genus described below, which is more related to two other Malayan genera adopted below. To these five genera all species from the Old-World enumerated above can be referred, while the three American ones must be reduced to one species differing widely from the others and made the type-species of a new genus below.

The old genus *Drymoglossum* is thus by me divided into six genera, which are certainly very similar as to several characters but nevertheless quite different and genetically not nearly related. *Lemmaphyllum*, f. inst., is clearly more intimately related to the three remaining genera of the "*Drymoglossinæ*", *Drymotænium*, *Hymenolepis* and *Paltonium*, than to *Drymoglossum* as here deli-

<sup>1)</sup> Ann. Jard. bot. Buitenzorg **36**: 140-148 pl. XI. 1926.

<sup>2)</sup> Bot. Mag. Tokyo **40**: 386-396. 1926.

mitated, and the three genera must, therefore, be dealt with before *Drymoglossum*. The relationship of each genus will be discussed below on the basis of a monographical review of the nine genera and their species.

### Key to the Genera.

1. Simple or stellate hairs none ..... 2
  - Leaves with stellate hairs and sporangia mixed with stellate or branched hairs; leaves dimorphous. . . . . *Drymoglossum* pag. 83
2. Sporangia mixed with peltate scales or with filiform paraphyses 3
  - Sori without scales and paraphyses; leaves dimorphous, the fertile ones very contracted, linear ..... 7
3. Leaves dimorphous or conform, in the latter case the fertile ones not with a "spike"-like apical contracted fertile portion ..... 4
  - Leaves conform, the fertile ones with a contracted apical fertile "spike" ..... *Hymenolepis* pag. 54
4. Leaves dimorphous, the sterile ones orbicular, obovate or elliptical, the fertile linear or narrowly spatulate
  - Lemmaphyllum* § *Eulemmaphyllum* pag. 44
  - Leaves conform ..... 5
5. Leaves lanceolate, flat; sori superficial ..... 6
  - Leaves linear, the sori immersed or covered by the strongly revolute edges ..... *Drymotænium* pag. 52
6. Sporangia mixed with peltate scales. Asiatic species.
  - Lemmaphyllum* § *Pseudovittaria* pag. 45
  - Paraphyses none or few, filiform. America. *Paltonium* pag. 70
7. Leaves with scattered minute scales on both surfaces.
  - America ..... *Marginariopsis* pag. 42
  - Leaves naked. Asia ..... 8
8. Sterile leaves short, ovate, obtuse, entire except in *Pycnoloma murudense*; venation less complicated ..... 9
  - Sterile leaves lanceolate or ovate-lanceolate, acuminate, coriaceous; main-veins strong, prominent below, the margins notched ..... *Grammatopteridium* pag. 80
9. Scales with thick walls (clathrate); sterile leaves rather thin with thin edges; all areoles, also the costal ones with a free veinlet that runs toward the midrib. Coenosori superficial ..... *Myuropteris* pag. 73

Scales with thin walls; sterile leaves coriaceous with the margins much thickened, entire or, in *P. murudense*, notched; main-veins invisible or, in *P. murudense*, strong and prominent; costal areoles without free veinlets, those of the outer ones running toward the edge; coenosori more or less sunk in grooves.. *Pycnoloma* pag. 75

To the genus *Drymoglossum* or *Pteropsis* three American species were hitherto referred: *D. Wiesbaurii* Sodiro, *D. martinicense* Christ and *D. Underwoodianum* (Maxon) C. Chr. They were distinguished by a key given by MAXON Contr. U. S. Nat. Herb. 16: 51. 1912. Being convinced that the Asiatic species of the genus are derivatives of certain groups of *Polypodium* and *Cyclophorus* not represented in America it seemed to me *a priori* very improbable that species of *Drymoglossum* should be found there. Having now examined type- or cotype-specimens of the three species I find that, as suspected, they are widely different from the Asiatic species.

One of the three species, *D. martinicense* Christ, described from specimens from Martinique (Duss 250b), was apparently founded on mixed material. The type-specimen in Berlin-Dahlem is a meagre one and does not belong to *Drymoglossum* but to that form of *Cyclophorus adnascens* (Sw.) Desv. described and illustrated by BLUME as *Niphobolus carnosus* (Fl. Javae 50 pl. 19). The more complete specimens in Christ's own herbarium (now in RB) belong to a common form of *Drymoglossum piloselloides*. I presume that both specimens were collected as escapes from gardens, where the two common Asiatic species have been cultivated.

The other two species, *D. Wiesbaurii* from Ecuador and *D. Underwoodianum* from Costa Rica, are to me not specifically different and are united into one species below. This is so different from all Asiatic species in important morphological characters as well as in its relationship that I venture to make it the type-species of a new genus:

#### **Marginariopsis** genus novum.

Leaves dimorphous, entire, the sterile ones lanceolate or ovate-lanceolate, furnished with minute peltate scales on both surfaces; veins anastomosing as in *Polypodium lycopodioides* and related species (*venatio Phlebodii*); fertile leaves narrowly linear.

Sporangia forming linear coenosori, borne on broad, medial, superficial receptacles, which run continuously from the base to short of the tip; paraphyses none or very few, filiform.

Type-species: *Drymoglossum Wiesbaurii* Sod.

In gross characters this Andine genus agrees fairly well with the Asiatic species of "*Drymoglossum*", this taken in the old sense; the wide-creeping rhizome, the dimorphous leaves, the contracted linear fertile ones with a linear receptacle are very similar, but as to other characters it is very different. These differences are mentioned below in some detail.

The only species hitherto known must now be named

**Marginariopsis Wiesbaurii** (Sodirol) C. Chr. comb. nov. — Plate VI fig. 3.  
Syn. *Drymoglossum Wiesbaurii* Sodirol, Crypt. Vasc. Quit. 419. 1893.

*Pteropsis Underwoodiana* Maxon. Contr. U. S. Nat. Herb. 16: 51 pl. 28. 1912.

*Drymoglossum Underwoodianum* C. Chr. Ind. Suppl. 28. 1913.

Type from Ecuador, near Rio Chimbo, I. SODIROL (not seen).

To the excellent descriptions of SODIROL and MAXON I shall add some remarks only which intend to prove the relationship of this interesting species.

The scales of the rhizome are ovate, brown, concolorous, finely dentate or subentire, consisting of clear cells with thin walls. The venation of the nearly sessile ovate-lanceolate sterile leaf is very different from that of the species of the Old-World but not materially different from that of *Polypodium lycopodioides* and its allies. Its main feature is that the principal lateral veins, which are scarcely stronger than the others, form large oblique areoles reaching a little beyond the middle of the way to the edge; these areoles are filled with a rather irregular network of veins that form mostly oblong areoles and one narrow costal one; beyond the larger areoles are to be found 2 or 3 rows of smaller angular ones; free included veins few or none; the outer free veins terminate in a hydathode well within the margin; all veins rather distinct. Both surfaces are furnished with scattered punctiform ovate or suborbicular peltate scales. The fertile leaves are stalked, linear, 4—5 mm. broad, their underside the tip excepted covered with sporangia; these are borne on a continuous, broad not immersed receptacle midway between costa and edge, the leaf-tissue outside the receptacle like the upperside with small peltate scales.

Ecuador: ad viam Quito-Manabí (SODIROL, BP).

Costa Rica: Llanuras de Santa Clara (DONNELL-SMITH 6941 W, type of *Pt. Underwoodiana* Maxon); Llanuras de San Carlos (A. and C. BRADE 461 B, W SB); Vicinity of Guápiles, Prov. of Limón, 3—500 m. (STANDLEY 37098 W); El Silencio, Prov. Guanacaste, 750 m., on tree (STANDLEY 44664 W).

I do not hesitate to reduce *Pteropsis Underwoodiana* Maxon to a synonym of *M. Wiesbaurii*, as the differences between them pointed out by MAXON in his key, chiefly found in the size, the form from Costa Rica being larger than the type, are not constant; STANDLEY no. 44664 f. inst. comes very near to the type. In some leaves the large areoles are not always closed outwards by a distinct arching vein.

The relationship of *Marginariopsis* is quite clear to me. It differs from all Asiatic drymoglossoid genera by the structure of the scales and venation. In several respects the whole habit of the plant recalls certain species of *Elaphoglossum* and as a matter of fact the type-specimen of *Pteropsis underwoodiana* was distributed as *Acrostichum* (*Elaphoglossum*) *amygdalifolium*. Of its alliance with *Elaphoglossum* the scales of the surfaces seem to be a proof, but on the other hand no species of *Elaphoglossum* has a similar venation. We find, however, very nearly the same venation in several American species of *Polypodium*, f. inst. *P. lycopodioides*, *P. geminatum*, *P. Lindbergii*, *P. recreense*, *P. percussum* and others. Of these *P. lycopodioides* has more or less dimorphous leaves and in most other characters resembles *Marginariopsis*, but its leaves are without scales on the surfaces; the other species named have uniform leaves and one, *P. percussum*, has the surfaces clothed with scattered scales like *Marginariopsis*. Further we find in the common American *Pol. piloselloides* L. a species that by dimorphous fronds and scaly pubescence is evidently related to *Marginariopsis*; its venation is principally the same but less complicated owing to the narrowness of the leaves. All the species of *Polypodium* named are no doubt related, but were incorrectly referred to two subgenera: *Marginaria* and *Pleopeltis* in Index Fil. I do not intend here to discuss how the American species of *Polypodium* with more or less irregularly reticulated veins should be grouped together in a natural manner but confine myself to pointing out that *Marginariopsis* must be regarded as an offshoot from the said group of *Polypodium*; it has proceeded farther in dimorphism together with the development of coenosori, but has otherwise retained all more important characters, which we find again in its sister-species with polypodioid sori.

**Lemmaphyllum Presl, Epim. 157. 1849.**

*Drymoglossum* sp. auctt., Ind. Fil.

Rhizome creeping on rocks or tree-trunks, the scales peltate, ovate-lanceolate, entire or shortly ciliate. Leaves dimorphous or uniform, the veins

anastomosing and forming areoles with or without free included veinlets, no main-veins present. Sporangia borne on a linear, continuous or sometimes interrupted receptacle parallel to the midrib and edge and confined to the outer half or two-thirds of the lamina, as young covered with clathrate, umbrella-shaped, fuscous and often iridescent scales that are deciduous and often quite absent in older leaves. Spores smooth or obscurely verrucose.

Type-species: *L. spatulatum* Pr. and *L. carnosum* (Wall.) Pr.

The species referred to this genus below belong to two rather different sections:—

1. **Eulemmaphyllum.** Leaves dimorphous, the sterile ones roundish or elliptic, short-stalked, the fertile linear or spatulate on longer stalks; rhizome thin, wide-creeping.
2. **Pseudovittaria.** Leaves conform or nearly so, lanceolate; rhizome short-creeping.

To the former section belong a small number of forms from Eastern Asia and Himalaya, which could all very naturally be referred to a single species with several geographical races or varieties. As these varieties have a limited geographical distribution, I prefer to deal with some of them as species. NAKAI, making *Lemmaphyllum* a section of *Drymoglossum*, referred all forms to three species and one variety, but I cannot agree with him on some points, being of opinion that the different forms should be arranged otherwise. The differences between the four species adopted in the following are chiefly found in the size and shape of the leaves; as to minute characters they all seem very alike.

The three species of the section *Pseudovittaria* (*Paltonium* sp. auctt.) seem rather different, but in reality they differ from the true *Lemmaphyllum* by their uniform leaves only, and it seems quite natural to place them in the same genus, inasmuch as one species (*L. abbreviatum*) is intermediate between the two sections. This systematic arrangement does not mean that all species are closely related to each other, a question further discussed below.

#### Key to the Species.

1. Leaves dimorphous, the sterile ones round to elliptical, the fertile linear or spatulate (*Eulemmaphyllum*)..... 2
    - Leaves uniform, lanceolate (*Pseudovittaria*)..... 5
  2. Sterile leaves naked or at best with some few scattered fuscous, clathrate scales beneath..... 3
    - Both surfaces of the sterile leaves rather densely chaffy by rufous scales ..... 2 *L. squamosum*
  3. Fertile leaves spatulate..... 4
    - Fertile leaves linear ..... 4 *L. carnosum*
  4. Sterile leaves orbicular, oval or obovate, 1—2 cm. long
    - 1 *L. microphyllum*
- Sterile leaves elliptical, 5—6 cm. long. Philippine Islands
- 3 *L. spatulatum*

5. Leaves rarely 10 cm. long, the sori confined to the somewhat contracted apex, seldom more than 1 cm. long..... 5 *L. abbreviatum*  
 Leaves 15—30 cm. long; sori occupying the upper half or two-thirds of the blade ..... 6
6. Veins scarcely visible. Southern China..... 6 *L. sinense*  
 Veins raised below. New Guinea ..... 7 *L. novoguineense*

### 1. *Eulemmaphyllum*.

1. *Lemmaphyllum microphyllum* Presl, Epim. 263. 1849. — Plate V fig. 1—4.

*Drymoglossum microphyllum* C. Chr. Ind. 246 with synonyms, NAKAI l. c. 393.

*Drymoglossum subcordatum* Fée, 3. mém. 29, 5. mém. 94 pl. 9 A fig. 1, 1850—52, pro parte.

*Drymoglossum carnosum* var. *subcordatum* Bak. Syn. Fil. 397. 1868, Makino, Ic. Phan. et Pter. Japon. pl. 27 et auctt.

Type from Japan. As PRESL only with doubt referred *Pteris piloselloides* Thbg. Fl. Jap. 331 to this species, to which it really belongs, the type-specimen must be one gathered by SIEBOLD, whose name is quoted by PRESL (NAKAI l. c. 394, perhaps by some error, calls the collector of the type: Schultes).

Rhizome-scales clathrate, from an ovate light-brown, lacerate-fimbriate, appressed basal part narrowed into a long dark-brown entire or subentire hairlike apex. Sterile leaves of the typical form mostly orbicular with rounded or sometimes subcordate base, or ovate with short-cuneate base, 0.5 to 10 mm. broad, the stalks 1 to 2 mm. wide; surfaces naked, or sometimes with some few brown, ovate clathrate ciliate scales beneath; fertile leaves spatulate, 2 to 3 mm. wide, rarely 5 cm. long. Spores smooth.

This typical form (Plate V fig. 1) is distributed from Southern Japan and Corea with the islands of Quelpaert and Tsushima and very similar forms are met with in the Liu-Kiu-Archipelago and Formosa, although it is probable that such specimens with roundish sterile leaves are young branches of individuals belonging to the varieties occurring in these southern islands. In Quelpaert a form occurs in which the sterile leaves are elliptical in outline and cuneate at base, thus being intermediate between the typical form and the variety *obovatum* (TAQUET 48 and 3645). Also in Japan plants may be found with some leaves typical, others quite like var. *obovatum*. — In China typical *L. microphyllum* seems to be rare and confined to the Southeastern Provinces:

Fukien: Kuliang Hills near Foochow (J. B. NORTON 1085 W), Amoy (C. DE GRIJS, Wi), Yuanshan (H. H. CHUNG 1202, Kew), near Diongloh (Fukien Christian University 2560 CC, 2623 W).

Kwangtung: Rather common in the island of Hongkong and neighbouring islands and in Hongkong New Territory, gathered by almost all collectors. — Thai-Yong, west of Swatow (DALZIEL, Kew), near Fungwan, North River Region (Canton Chr. Coll. 12865, CC).

Kwangsi: Yao shan (SIN et WHANG 1512, B).

The specimens from Hongkong differ slightly from the Japanese type by the sterile leaves being furnished with more scales beneath (Plate V fig. 2); this form is *Dr. subcordatum* Fée (l. GAUDICHAUD). Some of these specimens from the main-land approach *Polypodium drymoglossoides* Bak. (Plate V fig. 8—9) so much that they can only be distinguished from it with difficulty. The leaves of these specimens (f. inst. C. C. C. 12865) are partly subdimorphous; besides the typical spatulate fronds some others are found that are similar to the sterile ones, though larger and ovate-oblong (2—2.5 cm. long, 7—8 mm. broad), but fertile, the sori often interrupted, sometimes fully polypodioid.

var. *obovatum* (Harr.) C. Chr. comb. nov. — Plate V fig. 3.

*Drymoglossum carnosum* var. *obovatum* Harrington, Journ. Linn. Soc. Bot. 16: 33. 1878.

*Drymoglossum obovatum* Christ, Journ. de Bot. 19: 73. 1905, pro parte; C. Chr. Ind. 246; Nakai l. c. 395 (excl. var.).

Stipes of sterile leaves 1 to 4 cm. long, the blade ovate or spatulate, long cuneate at base; fertile leaves generally much larger than in the type, 3 to 6 cm. long, 4 to 5 mm. wide fig. 3).

Formosa (STEERE 487, type, W, HANCOCK 29, FAURIE 633, OLDHAM 68, WARBURG 9444, 9499, 10937, S. YANO 239, 415, HENRY 1406, and others).

Liu Kiu Isl. (DÜDERLEIN, B; FAURIE 38).

Japan, south (C. WRIGHT, A. W. STANFORD s. n.).

Hainan (ERYL SMITH 1506, Cal. 1, 1508 W).

Annam: Ngô Xá (CADIÈRE 91, RB).

The most developed form of this variety looks considerably different from the type, but smaller specimens, among them the original one, are so like the cuneate-spatulate fronds of the type often found together with the roundish ones, that it is most natural to consider this large form a variety of *L. microphyllum*. NAKAI finds a difference in the fertile fronds, those of the type being narrowly of the latter broadly marginate, i.e. the sori being more or less remote from the margin, but this difference is due to the width of the frond, as the position of the sori is essentially the same. Also in this variety some of the ordinary sterile leaves can be partly fertile with polypodioid sori (fig. 3c).

var. *lutchuense* (Nakai) C. Chr. comb. nov. — Plate V fig. 4.

*Drymoglossum obovatum* var. *lutchuense* Nakai l. c. 396.

Sterile leaves ovate, cuneate or rounded at base, 1.5 to 2 cm. broad, very thick and coriaceous with thickened margins, often distinctly nigropunctate above, the stipe short; fertile leaves on longer stalks, often linear and generally smaller than in the former variety.

Liu Kiu Islands: often collected (f. inst. FAURIE 4602).

Hainan: Sha Po Shan (Ts'ang Wai Tak 16074 p.p. Cal.).

Tonkin: Pays du Cai-Hint, village de Guan-Lan (CHEVALIER 29698 RB).

This variety is intermediate between the type and *L. carnosum* and could just as well be referred to that species as a variety<sup>1)</sup>.

**2. *Lemmaphyllum squamosum* sp. nov.** — Plate V fig. 5.

Rhizome filiform, wide-creeping, the scales rufous from a thin lacerate base narrowed into a hair-fine long entire apex. Leaves extremely dimorphous, the sterile ones (of the type-specimen) less than 1 cm. long, 2—3 mm. wide, elliptic, on a stalk 1—2 mm. long, both surfaces clothed with numerous rufous, lanceolate, lacerato-ciliate small scales. Fertile leaves on stalks 2—3 cm. long, the blade 3—5 cm. long, 0.5 cm. wide, linear, obtuse, scaly above like the sterile ones, the coenosori medial, wholly covered by orbicular fuscous scales.

Tonkin: Cao Bang, leg. BILLET (RB).

Although the type-specimen is a scanty one, consisting of two fragments of the rhizome with two scarcely fully developed sterile leaves and two full-grown fertile ones, I venture to describe this remarkable fern as new. It differs from the other species of *Eulemmaphyllum* by the chaffy leaves and rufous rhizome-scales.

<sup>1)</sup> Among BALANSA's Tonkin plants I find a fern that resembles *L. microphyllum* so closely as to size and shape of the leaves that it is partly excusable that BAKER has referred it to that species. It is, however, not a *Lemmaphyllum* at all but an undescribed species of *Loxogramme* and may properly be called:

***Loxogramme microphylla* sp. nov.** Plate III, fig. 6.

*Drymoglossum subcordatum* var. *obovatum* Baker, Journ. Bot. 1890: 267.

Species parva, habitu magnitudine foliis dimorphis *Lemmaphyllo microphylo* proxime similis. Rhizomate tenui, late repente, paleis lanceolatis, clavis brunneis, nitidis, tenuibus, integris vestito. Foliis dimorphis, coriaceis, glabris, sterilibus sessilibus, orbiculatis vel obovatis, 0.5—1 cm. longis, raro ultra, 7—8 mm. latis; fertilibus spathulatis vel oblanceolatis, 2—3 cm. longis supra medium 3—5 mm. latis, versus basin longe cuneatis, apice obtuso vel subacuto, costa mediana supra elevata, subtereti vel ad basin subangulata, subtus applanata, infra apicem evanida. Soris 5—6 mm. longis, 3—5 utroque latere, fere a costa ad marginem productis, ascendentibus, denique confluentibus.

Tonkin: Roches moussues du Mont Bavi, près de la vallée de Lankok, leg. B. BALANSA 12. Juin 1888, no. 1934 (Mus. Jard. princ. Leningrad, B).

In old fertile leaves the upper half of the underside is covered with sporangia and the species is then extremely similar to *Lemmaphyllum microphyllum*, from which it differs, however, not only by the sori but also by different scales and the more coriaceous texture. Within the genus *Loxogramme* it appears to be a most distinct species. The only known species with round sterile and spatulate fertile leaves is *L. conferta* from the Philippines and Borneo, which differs from our species by the larger cordate sterile leaves which are very close and imbricating, and by its densely brown-hairy roots. Our new species is more closely related to *Loxogramme acroscopa* (Christ) C. Chr.

3. *Lemmaphyllum spathulatum* Presl, Epim. 158. 1845. — Plate V fig. 6.  
*Drymoglossum carnosum* ex parte, Nakai l. c. 392 with a sketch of  
Presl's type-specimen from Luzon, leg. Meyen.

Sterile leaves elliptic in outline, often somewhat acutish, cuneate at base, 5—6 cm. long, 2—5 cm. broad, naked; fertile ones distinctly spathulate, not much longer than the sterile, 6—8 mm. broad, long-cuneate at base and with a contracted sterile apex.

By NAKAI united with *L. carnosum*, still it seems to me so distinct by the uniform elliptic large sterile leaves and the broad, spathulate fertile ones, that I prefer to deal with it as a distinct species.

Only known from the Philippine Islands:—

Luzon: Manila (MEYEN, type, not seen); Tonglon (LOHER 844 RB, *Kew*);  
Mt. Santo Tomas (TOPPING 1212 W, ELMER 6562 W, *Kew*); Baguio  
(WILLIAMS 1580 W, COPELAND 1840).  
Mindanao: Mt. Davao (COPELAND 349, *Kew*).

4. *Lemmaphyllum carnosum* (Wall.) Presl, Epim. 158. 1849 — Plate V  
fig. 7a—d.

*Drymoglossum carnosum* (Wall.) J. Sm., in Hook. Gen. Fil. pl. 78 A  
1841; C. Chr. Ind. 246 with syn.; Nakai l. c. ex parte.

Type from Nepal, leg. WALLICH (cotypes in various herbaria).

Sterile leaves short, ovate, or long, elliptic, rarely lanceolate, the smallest about 1 cm. long and wide, the largest 6.5 cm. long by 2.5 cm. wide; fertile ones usually much longer on stalks 4 to 6 cm. long, the blade 10 cm. long by 2 to 3 mm. broad, linear or lanceolate. Veins often visible in dried specimens; some minute castaneous substellate scales may be found scattered over the underside of young leaves. Spores obscurely verrucose or nearly smooth.

Very variable; some forms are nearly identical with *L. microphyllum* var. *lutchuense*, but the larger forms seem distinct enough by their large sterile leaves and especially by the long-stalked and long and narrow fertile ones. A very small form from Sikkim (CLARKE 27701, *Kew*) with sterile leaves 1 cm. or less long and broad and nearly sessile fertile ones 2 cm. × 3 mm. may be mistaken for *L. microphyllum* though the fertile blade is lanceolate (broadest below the middle). Another specimen from Sikkim l. LEVINGE (*Kew*) has fertile leaves about as broad as the sterile ones and the sori much interrupted, almost polypodioid, thus very much resembling *Polypodium subrostratum*.

comb. nov. Plate III, fig. 4. (*Polypodium acroscopum* Christ, Journ. de Bot. 19: 75. 1905) from Annam (Cadière 1201) and to *L. grammitoides* (Baker) C. Chr. Index, Suppl. prél. 21. (Plate III, fig. 5). (Syn. *L. spatulata* Cop. Phil. Journ. Sci. 30: 331. 1926!) from Central-China, but both of these have uniform leaves, as far as they are known. It is possible, however, that the latter species has subdimorphous leaves and in this case it differs from our new one chiefly by being twice or three times as large.

*L. carnosum* is distributed in Eastern Himalaya from Sikkim to Khasia and Yunnan eastwards to Tonkin. I have examined a considerable number of specimens from Himalaya and besides these the following:—

S. E. Tibet (G. FORREST 18924 *B*, *Kew*).

Yunnan (HENRY 9869 A, 9869 B, 11372 A, 11372 B, *B*, *Kew*, HANCOCK 142, *W*, *Kew*, HANDEL-MAZZETTI 9381 *Wi*, J. F. ROCK 7957 a, *H*, G. FORREST 16140, *B*, *Kew*).

Tonkin: Massif du Pia Ouac (PETELOT, *P*).

Siam: Doi Sutip (KERR 3478, *Kew*).

NAKAI refers to this species specimens from Shen-si, leg. ABBÉ DAVID, which I have not seen, but others from the same Chinese province also named *Dr. carnosum* belong to *Polypodium drymoglossoides*.

## 2. *Pseudovittaria*.

### 5. *Lemmaphyllum abbreviatum* (Fée) Kuhn ms. comb. nov. — Plate VI fig. 2.

*Drymoglossum abbreviatum* Fée, 7. mém. 26 pl. 10 fig. 2. 1857.

*Hymenolepis abbreviata* Fée 10. mém. 12. 1865.

*Polypodium abbreviatum* C. Chr. Ind. Suppl. prél. 25. 1917.

*Polypodium hymenolepioides* Christ, Journ. de Bot. 19: 75. 1905; C. Chr. Ind. 534.

Type from Cochinchina, leg. GAUDICHAUD (cotype in *B!*).

Rhizome wide-creeping, about 1 mm. thick, the scales lanceolate, fuscous, very thin and translucent, shortly dentate. Leaves coriaceous, subisomorphous, still the sterile ones generally much shorter than the fertile, 4—5 cm. long, 7—8 mm. broad, elliptic, acute, short-cuneate below, the stipe 0.5—10 mm. long. Fertile leaves either lanceolate 5—10 cm. long, 5 mm. broad, or elliptic, 5—8 cm. long, up to 1.5 cm. broad. Veins hidden; some few clathrate easily deciduous scales may be found on the underside below. Coenosori very short, some few millimetres long, rarely over 1 cm., confined to the tip of the fertile leaves, which often are somewhat constricted below the sori, the receptacles continuous or sometimes interrupted, midway between midrib and edge. Clathrate paraphyses not seen but no doubt present in young sori; spores smooth.

This species, forgotten for half a century and known only from FÉE's excellent figure, was rediscovered in Annam by CADIÈRE (no. 97!) and described by CHRIST as a new species, *Polypodium hymenolepioides*. Its systematic position has been doubtful to the authors. Originally described as a *Drymoglossum* by Fée it was later transferred by him to *Hymenolepis*, and Christ (l. c.) was in doubt whether he should place it under *Polypodium* or *Hymenolepis*. Without comments NAKAI (l. c. 387) says that it is the true *Drymoglossum rotundifolium*, but this identification is in every respect wrong. The species certainly resembles a dwarfish *Hymenolepis* by its apical sori, but the wide-creeping slender rhizome and not nearly so contracted fertile apex look rather different from all species of that genus. On the other hand it differs from *Lemmaphyllum* by the less dimorphous leaves only and its

natural position seems to me to be in this genus, to which KUHN referred the cotype-specimens in Herb. Berol. Moreover it is an intermediate form between *L. microphyllum* and the following species.

6. *Lemmaphyllum sinense* (Christ) C. Chr. comb. nov. — Plate VI fig. 1.

*Neurodium sinense* Christ, Bull. l'Herb. Boiss. 6: 880. 1898.

*Paltonium sinense* C. Chr. Index 477.

*Polypodium neurodioides* C. Chr. ined.

Type from Yunnan, A. HENRY 10434 (*RB*/).

Rhizome creeping, the scales, peltate, clathrate, ovate-acuminate, finely ciliate or subentire, fuscous brown, often darker in the centre. Leaves approximate, not dimorphous, lanceolate, up to 25 cm. long, 1.5 cm. wide below the middle (in HENRY 11518 B 5 mm. only), long attenuate toward the acuminate point, shorter toward the stipe, which is 2—4 cm. long, subcoriaceous or papyraceous, furnished beneath with some clathrate ovate scales, especially near the midrib below. Veins hidden or faintly visible, forming 2—3 rows of irregular areoles with free included veinlets. Coenosori continuous or interrupted in the upper half or two-thirds of the lamina, about 1 mm. from the margin, when young covered by clathrate scales.

Yunnan: Mengtze (HENRY 10434, 11518 A, *RB*, *Le*), HANCOCK 196, *Kew*, *W*), Szemao (HENRY 13072, *Kew*, *RB*); Mong Ka plain, between Tengyueh and the Burmese border (ROCK 7365, *H*, *W*).

Burma: between Sadon and the Yunnanese border at Changtifang and Kambaiti (ROCK 7488, *H*, *W*).

The specimens quoted are all typical with long linear coenosori, which are not rarely interrupted in the lower part. With them I am inclined to associate some specimens from Yunnan (ROCK 7113, 8727) with the coenosori interrupted throughout, so that either several oblong or linear sori are formed or the sori are round and perfectly polypodioid. Between the latter extreme and the type all intermediates seem to be extant, and it is at least not unnatural to consider them all forms of one species, although it may sometimes be almost impossible to see how the polypodioid forms may be safely distinguished from *Polypodium lineare* and *P. loriforme*, and such forms have no doubt been named *P. lineare* by all previous writers. In my paper on ROCK's ferns, soon to be published, I have followed the opposite view and referred all these forms to *Polypodium*, creating for them the new name *P. neurodioides*, and this treatment is certainly also a natural one. There remains the possibility that the forms with interrupted sori belong to a distinct species intermediate between *L. sinense* and *Pol. lineare*, but my material is not now sufficient for a safe segregation of these closely allied forms. The structure of the scales may perhaps give good characters. The only sure thing is that *L. sinense* is a very close ally of *P. lineare*.

7. *Lemmaphyllum novoguineense* (Ros.) C. Chr. comb. nov.

*Paltonium novoguineense* Rosenstock, Nova Guinea 8 : 729. 1912.

Type from Dutch New Guinea: Hellwig Mts., l. VON ROEMER 1140 (*Bog*, a scanty specimen); larger complete specimens from Papua: Schradersberg (LEDERMANN 11760, 11814 B).

Very like *L. sinense* but considerably larger; the lanceolate uniform leaves up to 30 cm. long and 2.5 cm. broad in the sterile part. Scales of the slender, wide-creeping rhizome ovate-lanceolate, very thin and pellucid, entire; similar ones are found scattered on the stipe and midrib below. Veins all distinct, the larger ones prominent on both sides, the main veins subdistinct, flexuose, forming 4—5 rows of sexangular areoles with free included veinlets. Coenosori confined to the distal half of the frond, which is somewhat contracted, about 1 mm. broad, the receptacles running continuously about 0.5 mm. within the margin till short of the tip. Young sori covered by clathrate scales, which soon drop and are not mentioned by ROSENSTOCK.

A distinct species which is intermediate between *Lemmaphyllum* § *Pseudovittaria* and *Hymenolepis*, in size, venation and scales agreeing closely with some species of the latter genus (*H. squamata*) but the fertile portion of the blade not spike-like although somewhat contracted.

#### *Species dubia.*

**Paltonium vittariiforme** Rosenstock, in Fedde, Repertorium 10: 341. 1912.

— Plate VII fig. 1—2.

New Guinea: Cromwell Mts. (G. BAMLER, Herb. Rosenstock!).

By the kindness of Professor ROSENSTOCK I was enabled to examine the type of this remarkable fern. It was founded upon a single leaf without rhizome gathered together with a species of *Vittaria*. In habit it resembles perfectly a larger species of *Vittaria* with intramarginal sori, but the lack of spicule-cells and the venation show that it does not belong to that genus. The long coenosori are quite identical with those of *Lemmaphyllum sinense*, but the venation is much less complicated and the paraphyses are filiform with a cylindrical apical cell totally different from those of *Lemmaphyllum*. The species cannot, therefore, be referred to that genus, and its systematic position is very problematical. It is, perhaps, related to the curious *Diblemma samarensis* J. Sm., by some authors believed to be an aberrant form of *Polypodium tenuilore*.

#### *Unknown Species.*

**Paltonium dubium** Rosenstock, Meded. Rijk's Herb. Leiden nr. 31. 5. 1917.

Type from the Philippine Isl. l. CUMING no. 238.

Judging from the very short description this species differs chiefly from the three last mentioned by the somewhat immersed sori; scales not mentioned.

#### **Drymotaenium** Makino.

Bot. Mag. Tokyo 15: 102. 1901.

Rhizome short-creeping with dark clathrate peltate scales. Leaves uniform, narrowly linear or oblanceolate, *Vittaria*-like, glabrous and naked,

coriaceous. Veins deeply immersed, anastomosing and forming 1—2 rows of areoles with or without free veinlets; distinct main veins none. Coenosori linear, immersed, the sporangia in one species mixed with thin clathrate umbrella-shaped scales, in the other with filiform paraphyses.

Type-species: *Taenitis Miyoshiana* Makino.

This genus is closely related to the *Lepisorus*-group of *Polypodium*, and subsequently also to *Lemmaphyllum*, from which genus it differs mainly by the *Vittaria*-like habit and immersed sori, and it may be doubted whether these characters are sufficient for the segregation of the genus; considering dimorphism as an important character it would be quite natural to unite *Drymotanium* and the section of *Lemmaphyllum* called *Pseudovittaria* above into one genus, still the treatment here followed seems to me the best in order to show the near relationship of both genera to *Polypodium* § *Lepisorus*.

1. *Drymotanium Miyoshianum* Makino, Bot. Mag. Tokyo 15: 102. 1901; Phan. et Pteridoph. Jap. 1 pl. 12; C. Chr. Medd. Bot. Trädgård, Göteborg 1: 98. 1924. — Plate VII fig. 4.

*Taenitis Miyoshiana* Mak. Bot. Mag. Tokyo 12: 26. 1898 — (*Taenitis* sp. Mak. l. c. 3: 351 pl. 13. 1889).

*Pleurogramme robusta* Christ, Bull. L'Herb. Boiss. 6: 867. 1898.

*Monogramme robusta* C. Chr. Ind. 431.

*Vittaria suberosa* Christ, Bot. Gazette 51: 349. (not Bull. Soc. bot. France Mém. I: 12).

Type from Japan (not seen).

This very distinct and peculiar species has been described excellently by MAKINO, and a new detailed description is not necessary. In mode of growth and general habit it is like a species of *Vittaria*, but nevertheless very different from that genus by the thick coriaceous leaves being distinctly articulated to the short-creeping rhizome, by the ovate-acute or lanceolate, clathrate, blackish and rather thick, dentate scales, by the anastomosing veins (pl. VII) and by the presence of some few clathrate scales mixed with the sporangia. The coenosori occupy the distal half or three-fifths of the frond and when young are deeply immersed in a groove formed by the raised, thick, quadrangular "midrib" and the revolute edges.

This interesting species is evidently a near ally of some Chinese species of *Polypodium*, especially *P. eilophyllum* Diels. This resembles our species in almost all characters so closely that sterile leaves can scarcely be distinguished from it, but its sori are polypodioid, oblong, and the venation somewhat more complicated (plate VII fig. 3).

*D. Miyoshianum* is found in two separate regions; Southern Japan and South-western China. I have seen half a dozen specimens from Japan and find them quite identical with those from China, which belong to *Pleurogramme robusta* Christ, this name being thus a synonym. CHRIST has later named some specimens belonging here *Vittaria suberosa* Christ and I, therefore, in 1924, reduced that name to a synonym of *Drymotanium*, but wrongly. I have now on loan the type-specimen of *Vittaria*

*suberosa* l. FARGES from Herb. Bonaparte, and find it to be a genuine *Vittaria* with the characteristic thin hair-pointed clathrate scales and paraphyses of that genus; it comes very near *V. flexuosa* Fée.

The following specimens from South China have been examined.

Yunnan: Mengtze (HENRY 9149, type of *Pl. robusta* Christ, *RB*, *Kew*);  
Mts. of Tseku (J. F. ROCK 10057, *H*, *W*); Tche-hai (MAIRE, *RB*).  
Sze'chuan: Wa-shan (WILSON 2638, *RB*, *B*, *Wi*); Daliang-shan (HANDEL-  
MAZZETTI 1746, *H*, *Wi*).  
Hupeh (WILSON 1080, *Wi*).

2. *Drymotaenium Nakaii* Hayata, Bull. Soc. bot. France 58: 565 pl. 19. 1911.

Type from Formosa, leg. KAWAKAMI and U. MORI no. 1860, not seen, but a specimen from Mt. Arisan, Formosa, collected by HAYATA himself 1912 (*RB*) is no doubt typical.

This species was described and illustrated elaborately by HAYATA and I have only a few remarks to add. The specimen examined is larger than the original one, 25 cm. long by 4 mm. wide, not strictly linear but narrowly oblanceolate, the scales of the short rhizome ovate-acuminate, clathrate, brown with a black central stripe, shortly ciliated; surfaces naked and texture thickly coriaceous. Sori confined to the upper somewhat broader apical half of the frond, which is flat, forming continuous coenosori just within the margin, at least apparently marginal, immersed in a deep furrow; sporangia imbedded in a mass of filiform paraphyses.

A remarkable species, perfectly resembling a species of *Vittaria* in general appearance and sori, but the scales, texture, venation and paraphyses are, of course, very different. In all these characters but one it agrees well with *D. Miyoshianum*, differing slightly by the not linear but oblanceolate and nearly flat fronds, but very peculiar by the mass of filiform, septate paraphyses, which fill the grooves among the sporangia. By this character the species is unique and its systematic position is therefore doubtful.

**Hymenolepis Kaulfuss.**

Rhizome short-creeping with the leaves tufted or, in some forms, wide-creeping with scattered leaves, clothed with fuscous peltate, ovate, or lanceolate scales of different structure; the brown-tomentose roots often forming "Wurzelschwämme". Leaves entire, mostly lanceolate, the lower part of the fertile frond sterile, the upper fertile, spikelike; sterile portion resembling the whole sterile leaf, glabrous, the veins copiously anastomosing with free veinlets in the areoles, the primary veins ("main-veins") in some forms indistinct, in others distinct and raised beneath; fertile portion as a rule very much contracted, linear, commonly totally covered by sporangia; these are mixed with peltate, clathrate scales and as young form distinct linear superficial coenosori usually near the midrib, but are not always confined to the veins of the receptacle.

Type-species: *Acrostichum spicatum* L. fil.

The geographical area of *Hymenolepis* is Tropical Asia and Polynesia, extending east- and southwards to Tahiti and New Caledonia, northwards to South-China and westwards to the South-eastern African Islands, Tropical East Africa, and the islands of Tropical West Africa (a single find).

The small number of forms described as species are so uniform in gross characters that most authors have referred them all but one (*H. platyrhynchos*) to a single species, *H. spicata*, and it must be admitted that most species described were based on characters, f. inst. size, which rarely hold good. A detailed examination of a large material of herbarium-specimens has shown, however, that a number of distinct forms may be recognized. The late Professor G. HIERONYMUS had sorted the rich material in Herb. Berol. into a score of species, to which he partly gave new but never published names. These species were chiefly founded upon differences in the structure of scales and paraphyses and in venation. Having examined the same specimens I cannot follow HIERONYMUS in adopting so many species, some of which were based upon a single specimen, and I believe it to be more practical to delimit a smaller number of species, which may without difficulty be described in such a way that the specific characters may be easily understood by others.

A cursory examination seems to show that two or three characters are of value as specific ones. The size and shape of the lamina are certainly not characters of value, being extremely variable, even in leaves from the same rhizome. In most forms the sterile portion of the fertile leaf narrows very gradually into the spike, in some others suddenly, being nearly truncate below the spike; this difference cannot, however, be used as a specific character, as both forms are to be found in almost all species and not rarely in the same specimen. The venation is very uniform; the most important difference is found in the main veins, which in dried specimens may be nearly invisible and not stronger than the smaller veins, or they are stronger and distinctly raised on both surfaces. This difference was used by HIERONYMUS as a specific character, and certainly it is easily recognizable, but I fear that it does not hold good. Both forms may be found everywhere among individuals which are otherwise quite alike, and it seems probable that the difference is due, at least partly, to the season, wet or dry, in which the specimens were collected. Studies in the field only can prove if this hypothesis is right. Below I have reduced some of the species by HIERONYMUS based upon that character to varieties.

The best specific character is no doubt found in the structure of the scales. They are of two different types, which are described below in the key. The structure of the paraphyses corresponds closely to that of the rhizome-scales of the same species.

#### Key to the Species.

1. Scales of rhizome with thin margins. Walls of the marginal cells very thin, the radiating ones not protruding beyond the edge, which, therefore, is not toothed or ciliate but often uneven or lacerate; walls of central cells in some species thickened and

- blackish, the scales becoming blackish with light borders, in other species all walls thin, the structure being rather uniform throughout..... 2
- Scales of rhizome with toothed or ciliate margins. All cells with equally thickened blackish walls (clathrate scales), the radiating ones protruding shorter or longer beyond the margin, which thus becomes short-toothed or long-ciliate (properly speaking pseudociliate)..... 6
2. African species. Lateral veins generally very distinct and raised  
1 *H. spicata*
- Asiatic-Polynesian species..... 3
3. Midrib naked..... 4
- Midrib beneath with scattered clathrate scales, rhizome wide-creeping; main veins raised..... 3 *H. squamata*
4. Scales of rhizome rarely 1 mm. broad at base, the central cells with thick walls bordered by thin-walled marginal cells, especially at base. Spike narrow, rarely 3 mm. broad; lamina 1—2 cm. broad..... 2 *H. revoluta*
- Scales of rhizome large and numerous, 1 to 2 mm. broad at base, often shortly acute or even obtuse, glossy or iridescent, all cells with thin walls. Sterile blade 3 to 6 cm., spike 3 to 10 mm. broad..... 5
5. Leaf green..... 4 *H. validinervis*
- Leaf glaucous..... 5 *H. glauca*
6. Spike long and slender, rarely 4 mm. broad, covered with sporangia beneath, or broader and then with distinct submarginal coenosori..... 8
- Spike short and broad, 4 to 8 cm. long, 5 to 10 mm. broad..... 7
7. Leaf green; sporangia leaving a broad uncovered edge on both sides of the mature spike; scales distinctly pseudociliate  
11 *H. platyrhynchos*
- Leaf glaucous; scales faintly toothed..... 5 *H. glauca*
8. Leaves 1 to 2 cm. broad, rarely more, equally attenuate toward the spike, usually with a constriction at the base of the spike, the latter covered with sporangia beneath..... 9
- Leaves 2 to 6 cm. broad, commonly abruptly narrowed toward the spike without constriction; spike often very long..... 10
9. Leaves lanceolate, mostly 15 to 20 cm. long; paraphyses early falling..... 6 *H. mucronata*
- Leaves linear, 40 to 60 cm. long; paraphyses very numerous and subsistent. Samoa..... 7 *H. Vanpelii*
10. Rhizome scales spinescent-ciliate; leaves often 4 to 6 cm. wide, the spike 20 to 30 cm. long; sporangia covering the underside  
8 *H. callifolia*
- Rhizome scales faintly ciliate; sporangia forming distinct coenosori, at least covering the underside..... 11
11. Receptacles close to the midrib of the linear narrow "spike"; blade mostly abruptly and unequally contracted toward the spike..... 9 *H. Henryi*

Receptacles submarginal in the contracted but not spikelike apical part of the frond, which narrows from the base gradually; blade 4 to 5 cm. wide ..... 10 *H. annamensis*  
(se also *H. callifolia* var. *paltonioides*)

1. *Hymenolepis spicata* (L. fil.) Presl, C. Chr. Ind. 356 with synonyms, excl. *H. revoluta* et *H. validinervis*; Sm. Pl. Ined. pl. 49 (good).  
*H. ophioglossoides* Klf. Enum. 146. 1824; not auctt.

Type from Mauritius, leg. COMMERSON, distributed by THOUIN to various herbaria; cotype in Herb. Vahl (*H!*).

The scales of the short-creeping rhizome are fuscous with lighter edges, entire, ovate-acute, or short-acuminate. Lamina generally broadest at middle (1—2 cm.) and very gradually attenuate to both ends, the sterile tip often constricted and narrower than the spike; surfaces naked, the margins plane; main veins and the larger cross-veins distinct and raised below  $\frac{3}{4}$  or more of the way to the edge; spike 5—10 cm. long, 2—3 mm. broad.

Area: Mauritius, Réunion, Madagascar, Comoro and Sechelles Islands.  
— Varieties in Usambara and Ins. S. Thomé, W. Africa.

The rather numerous specimens examined from the East-African islands are as a whole very uniform, and in most of them the main veins are prominent, but this character is, as mentioned, not constant. In a single specimen from Mauritius (leg. LE MAIRE) they are fully obscure as they are in some from the Sechelles and Madagascar. Typical specimens from Madagascar were collected f. inst. by HUMBLLOT 293, BARON 3851 and FORSYTH MAJOR 199. Others represent perhaps a distinct geographical variety:

var. *occultivenia* var. nov.

All veins perfectly hidden, leaf smaller, more coriaceous. Differs from *H. revoluta* by the shape of the lamina which is broadest at the middle as in the type. — To this variety I refer a small specimen from the island of St. Thomé, Guinea Coast, the westernmost locality known for the whole genus.

Madagascar: Moramanga (PALM and AFZELIUS, *S*, *CC*); s. l. (W. POOL, MELLER, *Kew*); Betsitra (D'ALLEIZETTE 117, *RB*).

Sechelles: Mahé (HORNE 206, THOMASSET, DE L'ISLE, *Kew*).

St. Thomé: West Tropical Africa (F. QUINSTON(?), *Kew*).

var. *usambarensis* var. nov.

Leaf larger, 2.5—3 cm. broad at middle and much more shortly attenuate toward the spike, sometimes suddenly narrowed below the spike as in *H. Henryi*; main-veins indistinct, sometimes wholly obscure.

East-Africa: Usambara (C. HOLST 143, 7485 *B*, 9095 *B*, *RB*).

This may possibly be a valid species, but the scales are very similar to those of typical *H. spicata*, although somewhat larger, and in one of the specimens cited (nr. 9095) the main veins are clearly visible but not raised,

thus being intermediate between no. 7485, in which no stronger main-veins are present, and the type.

2. *Hymenolepis revoluta* Bl. Enum. 201. 1828; KUNZE. Farrnkr. 101 pl. 47 fig. 2.

*H. rigidissima* Christ, Bull. l'Herb. Boiss. II. 6: 990. 1906.

Type from Java, leg BLUME, cotypes in *B* and *Kew*.

Scales of rhizome very similar to those of *H. spicata*: ovate, short-acuminate, entire, their middle dark-brown, the edges lighter, often yellowish-brown. Leaves with rather long unwinged stipes, narrowly lanceolate (broadest below the middle), rarely exceeding 1 cm. in width, often narrower, very gradually and long attenuate towards the spike, the very narrow sterile tip as a rule narrower than the spike; surfaces naked, no prominent main veins and all veins often quite hidden; edges revolute and the whole leaf often conduplicate; spike very slender, up to 15 cm. long, 1—3 mm. broad.

*H. rigidissima* Christ is a small form of this species.

Java: Common and gathered by numerous collectors.

Malay Peninsula: Perak (King's collector 2146 *B*, 6373 *Si*, SCORTECHINI, L. WRAY, *Si*); Kedah (RIDLEY s. n., *Si*); Pahang (HOLTUM 8766, Mrs. ERYL SMITH 840, *Si*).

Annam: Nhatrang (POILANE 3757, *RB*).

Celebes: Tomohon (P. & F. SARASIN 41, *RB*).

Philippine Islands: Luzon, Batay (LOHER, type of *H. rigidissima*, *RB*); Baguio (McCLURE 15917).

New Guinea: Mt. Scratchley (10—13000 (MACGREGOR, *Kew*, a dwarfish form near *H. rigidissima*).

var. *planiuscula* (Mett.) Hieron. comb. nov.

*Taenitis revoluta* var. *planiuscula* Mett. Fil. Hort. Lips. 28. 1856.

Leaves larger on longer stipes (up to 10 cm.), the blade 1 to 3 cm. broad, plane, shortly attenuate toward the spike and often suddenly narrowed below the spike, as a rule distinctly constricted at the spike-base. — A weakly characterized variety, scarcely worthy of a name. I refer to it some Polynesian specimens, which in general habit come very near to *H. mucronata* and in scale-characters are about intermediate between that species and *H. revoluta*, the scales being entire with thin marginal walls but dark-brown throughout. In New Caledonia two forms of *Hymenolepis* occur, both of which are not rarely distributed under the same number, one showing the scale-characters of *H. revoluta*, the other of *H. mucronata* but otherwise they are scarcely different. I have here, following HIERONYMUS's identifications, referred these specimens to the two species, but I wish to say that this treatment is probably unnatural, and that all specimens belong to one species that may be specifically different from the two mentioned.

Ceylon s. l. (THWAITES 1303 p.p., *B*; FERGUSON 212).

Sumatra (BÜNNEMEIJER 4773).

Java, common and often collected.

Borneo: Sarawak (MjöBERG), Kinabalu (Mrs. CLEMENS 10224, 10396 *BSci*).

Philippine Islands: Luzon, Mt. Data (COPELAND 1859); Mt. St. Thomas (ELMER 5931); Mt. Tonglon (LOHER 1167); Baguio (WILLIAMS 1477).

— Negros: Dumaguete (ELMER 9650).

— Mindoro: Mt. Halcon (MERRILL 5999).

New Caledonia (BALANSA 2713, VIEILLARD 1588 p.p., CRIBS 1336, D'AL-  
LEIZETTE 621, FRANC 354 and ed. ROSENSTOCK: Fil. N. Cal. exs.  
115 p.p. and 139).

Tahiti (WILKES' Exp., VIEILLARD 4, LENORMAND, *B*, SETCHELL 195, 425  
and 539 *W*, BIDWILL).

var. *costulata* (v. A. v. R.) Hieron. comb. nov.

*H. spicata* var. *costulata* v. A. v. R. Bull. Jard. bot. Buitenz. VII: 19. 1912.

Differs from the type by the prominent main veins and by the generally  
very long spike, often 20 to 25 cm. long.

Sumatra (FORBES 2336 *B*, BÜNNEMEIJER 3894, WINKLER ed. ROSEN-  
STOCK: Fil. sum. exs. 65, LÖRZING 5926 *U*, RIDLEY *Kew*, BECCARI  
419 *Kew*).

Malay Peninsula: Perak (RIDLEY, *Si*).

Celebes: G. Bonthain (BÜNNEMEIJER 11958).

Philippine Islands: Mindanao, Mt. Apo (COPELAND 1026, ELMER 11443).

### 3. *Hymenolepis squamata* Hieron. ms. sp. nov.

Rhizome long-creeping, densely covered with broad, ovate-short-  
acuminate, thin, iridescent scales, all cell-walls thin, the margins faintly  
toothed, not ciliate. Leaves distant, blackish-brown as dried, their stalks  
3—5 cm. long, the blade 30—50 cm. long, 1—2 cm. broad, lanceolate or  
broadest at middle, gradually attenuate each way, the sterile tip slightly  
narrower than the spike, not constricted. Lateral veins very distinct  
and raised on both sides  $\frac{3}{4}$  of the way to the edge, the finer veins faintly  
visible, the upper surface nigropunctate from the blackish hydathodes,  
in which the free veinlets terminate; midrib beneath furnished with scattered,  
easily deciduous blackish glossy ovate-acuminate clathrate scales similar  
to those of the rhizome. Spike 5—15 cm. long, about 4 mm. broad, obtuse,  
the sporangia at maturity covering the whole underside.

Type from Luzon, I. E. A. MEARNS, Bur. Sci. 4205, *B*!

A very distinct species, characterized especially by the broad, thin-  
walled, glossy scales of the rhizome and midrib, the largest being nearly  
2 mm. broad at base, and by the prominent lateral veins. By the wide-  
creeping rhizome and the scales this species recalls certain species of *Poly-  
podium* § *Lepisorus* and *Lemmaphyllum* § *Pseudovittaria*.

Philippine Islands: Luzon: "Hights of the Oaks", Benguet Prov.  
(Bur. Sci.: 4205, TOPPING 1162), Pauai (COPELAND 1945, MCGREGOR

8527, SANTOS 31760), Mt. Pulog (MERRILL 6355, Bur. Sci. 44882), Mt. Data (Mrs. Clemens 16299). — Most specimens in *W* and *BSci*.

var. *borneensis* var. nov.

All veins about equally visible beneath, no stronger prominent main veins; spikes 3—5 cm. long only.

Borneo: Mt. Kinabalu (Mrs. CLEMENS 10664, *BSci*, type; TOPPING 1675, 1703).

Approaches *H. validinervis*, but size and scales of rhizome and midrib are like those of the type.

4. *Hymenolepis validinervis* Kunze, Bot. Zeit. 6: 132. 1848.

*Taenitis validinervis* Mett. Ann. Lugd. Bot. 4: 173 pl. 7 fig. 7—10. 186. 1868—69.

*Acrostichum spicatum*  $\beta$  *brachystachys* Hook. Garden Ferns pl. 3. 1862?

*Hymenolepis brachystachys* J. Sm. Ferns brit. and for. 92. 1866; C. Chr. Ind. 355.

*Taenitis ophioglossoides* Mett. Fil. Lips. 28 t. 15 f 13, t. 25 f. 19.

Type from Java, ZOLLINGER 2312, cotype in *B*!

Rhizome rather wide-creeping, densely covered with very large ovate-acute, sometimes obtuse, rarely acuminate, thin-walled, entire, fuscous-brown, somewhat glossy scales, the largest 2 mm. broad at base. Stipes strong, sometimes up to 10 cm. long; lamina naked, lanceolate, elliptical or sometimes oblanceolate, up to 70 cm. long, 3—4 cm. broad, long-cuneate toward the base, shortly attenuate upwards and as a rule gradually running into the spike without constriction, the sterile tip often 5—8 mm. broad; venation visible, the main veins a little stronger than the others but scarcely prominent in the type. Spike 5—20 cm. long, 5—8 mm. broad, when mature mostly covered by sporangia beneath still not rarely with a narrow uncovered edge on both sides, especially in the lower part.

Besides specimens cultivated in Hort. Lips. (*B*) and *Kew* I have seen the following:—

Sumatra (t. METT.).

Java: s. l. (ZOLLINGER 2312, F. JAGOR 668 *B*, PALMER and BRYANT 884 *W*), Mt. Gedeh (PULLE 4121 *U*), Tengger Mts. (BUYSMAN 62).

Philippine Islands: Mindanao, Mt. Apo (COPELAND 1026 *Kew*, WILLIAMS 2638 *W*), Mt. Matutum (COPELAND, Pterid. Phil. exs. 199, CC), Mt. Lipa (*BSci* 38502).

New Guinea, Papua, Schradersberg (LEDERMANN 11989 f., *B*).

*H. validinervis* is certainly very different from *H. revoluta* as well as from *H. mucronata*, distinguished not only by its large size but also by the large, thin-walled scales of the rather wide-creeping rhizome. By the latter character it comes near to *H. squamata*, and it is possible that the specimens from Mindanao referred here, which are furnished with some few broad scales on the midrib beneath are not safely distinct from *H. squamata*. They equally approach *H. glauca* and further material will perhaps prove

that all specimens from Mt. Apo, partly referred here, partly to *H. glauca* will appear to belong to a single species different from *H. validinervis*. Near to it come the specimens from Papua; they differ from the Javanese type by long-acuminate and faintly toothed scales.

As to the synonymy of this species I have little doubt that J. SMITH was right in identifying *H. brachystachys* with *H. validinervis* of the Leipzig Garden. *H. brachystachys* was originally described and illustrated from cultivated plants (a single leaf in *Kew!*), and HOOKER's plate shows a plant with sessile, broad leaves with subdistinct main veins and very short spikes. It agrees closely with the cultivated specimens in Herb. Mett. et Kuhn (*B*, also *RB*). On the other hand these specimens are very like the Javanese specimens quoted above and no doubt belonging to the same species, differing a little by shorter stalks, faintly prominent main veins and shorter spike; the type is well illustrated in Ann. Lugd. Bat. 4 pl. 7. Unfortunately all specimens of *H. brachystachys* J. Sm. lack rhizome and scales, so the final proof of its identity with *H. validinervis* is still lacking; it is quite possible that it may be a broad-leaved form of *H. mucronata*. I am almost sure that *Acrostichum brachystachyum* Racib. Pterid. Buit. 1: 51, *Hymenolepis brachystachys* v. A. v. R. Handb. 729 belongs to that and *H. brachystachys* var. *mirabilis* v. A. v. R. Bull. Jard. Buit. XXVIII 28 pl. 4. 1918, is, I think, a monstrous form of the same.

In Celebes a form occurs which I refer to *H. validinervis* as a variety. HIERONYMUS named it *H. brachystachys*, and it must be granted that in several characters it agrees better with HOOKER's plate than do the Javanese specimens, but because it has not yet been finally identified with the genuine *H. brachystachys* I prefer to give that form another name, viz.

var. *celebica* var. nov.

Rhizome rather short-creeping with scales like those of the type. Leaves sessile (unwinged stalk rarely 1 cm. long), main-veins prominent about halfway to the edge, spike 6—10 cm. long by 8—10 mm. wide, the sporangia leaving a narrow uncovered edge on both sides.

Celebes: G. Bonthain 2000 m. (BÜNNEMEIJER 12032, type, *B*, *Kew*, 11958, 11960 *Kew*, RIDLEY s. n., *Kew*), Manipi (WARBURG 16543 *B*, *RB*), Wawaj Kieng (WARBURG 16784 *B*), s. l. (P. & F. SARASIN, *RB*).

I have little doubt that it was this distinct variety, which Christ (Ann. Jard. Buit. 15: 180) and others meant when giving the locality Celebes for *H. platyrhynchos*. Some of the specimens quoted were referred to that species by CHRIST and v. A. v. R. and I have seen no specimens of it from Celebes. The present variety differs greatly from *H. platyrhynchos*, by scale-structure and the prominent main veins, resembling it a little by the short and broad spikes. Smaller forms of var. *celebica* run into *H. revoluta* var. *costulata*, but may as a rule be distinguished from it by the short and very broad spikes.

5. *Hymenolepis glauca* (Copeland) C. Chr. sp. nov.

*Hymenolepis platyrhynchos* var. *glauca* Copel. Elmer's Leaflets 3: 487. 1910.

Rhizome rather thick, creeping, glaucous under the scales; these numerous, broad, ovate-acuminate, brown, not glossy, shortly and distantly dentate, all cell-walls equal. Unwinged stipe mostly very short (1—2 cm.) or almost none; larger leaves 50—70 cm. long, 5 cm. wide at the middle and thence tapering very gradually to both ends, thinly papyraceous to subcoriaceous, both surfaces distinctly glaucous by a thin layer of wax which is easily rubbed off. Midrib strong and prominent, without scales beneath, the veins faintly visible, main veins not prominent. Spike (of the type) short and broad, 5—6 cm. long by 12 mm. wide (in one specimen 15 cm. long 5 cm. wide), the edges recurved. Sporangia covering the whole underside, mixed with numerous hyaline hairs, like the pedicels of the sporangia and sometimes widened at the apex into a clathrate scutelliform scale.

Philippine Islands: Mindanao. Mt. Apo (ELMER 11444, type; cotypes in *Le*, *RB*, *Wi*, *W*; 11432 *Le*, *W*); Butig Mts. (MEARNS s. n., *W*).

This interesting, local species resembles in several respects *H. platyrhynchos*, to which COPELAND referred it as a variety; in my opinion it is, however, more closely related to *H. validinervis*. It differs from both by its glaucous rhizome and leaves, from the former species by its larger size, less distinctly toothed scales and by the sporangia covering the whole underside of the spike, from the latter by the very short stipe and faintly dentate and thicker scales. See my remarks under *H. validinervis*.

6. *Hymenolepis mucronata* Fée, Gen. 82 pl. 6 B fig. 1. 1852.

*H. ophioglossoides* [Bl. Enum. 200?] Kunze, Farrnkr. 99 pl. 47 fig. 1, Carr. in Seem. Fl. Vit. 374 et auctt.

The name *Acrostichum ophioglossoides* Klf. Enum. 146 is a direct synonym of *A. spicatum* L. fil. = *Hymenolepis spicata*, to which species KAULFUSS referred a specimen from Guam leg. Chamisso, and it was, therefore, very improperly used for a Malayan-Polynesian species by BLUME 1828, PRESL 1849 (Epim. 160), KUNZE, METTENIUS and HIERONYMUS, while FÉE was right in changing the name of that species to *H. mucronata*.

As to the type and type-locality of this species the matter is rather complicated. FÉE quoted as synonym of his new name *mucronata* "(*Ophioglossoides* Blum., Kze. non Klfss.)", but the Javanese form so named by BLUME is not exactly identical with the plant excellently figured by KUNZE. It must now be remembered that KUNZE (l. c. 99) used the name *ophioglossoides* in the same sense as KAULFUSS, as identical with *spicata*, but his figure does not illustrate the true *spicata* but just the species named *mucronata* by FÉE. According to all evidence the plate illustrates a specimen from CUMING's collections from Luzon, probably no. 92, quoted by PRESL Epim. 160 and certainly also represented in FÉE's herbarium. After these considerations I consider CUMING no. 92 from Luzon as the type and more specially the specimen illustrated by KUNZE l. c.

Rhizome short-creeping, the scales dark-brown or blackish, concolorous, narrow lanceolate-acuminate to ovate-acuminate, uniformly clathrate throughout with thick blackish walls, the marginal, radiating ones protruding beyond the edge as cilia. Leaves tufted, more or less coriaceous, naked, lanceolate, short stalked, usually 15 to 25 cm. long by 1 to 2 cm. wide, rather shortly attenuate toward the spike with a constriction just below the spike (text-figure 1a). Veins generally faintly visible, the main veins slightly stronger but not prominent in the type. Spike proportionally short, rarely more than 10 cm. long by 1.5 to 3 mm. wide. Paraphyses with rather thick, blackish walls.

*H. mucronata* is a variable species, especially as to size of the scales and length of their marginal cilia and size of the leaves. I distinguish the following forms and varieties:—

1. f. *typica*.

Taking CUMING no. 92, of which collection I have seen two specimens (*Kew, W.*), as the type, I regard the form occurring in the Philippine Islands as the typical one. It is excellently illustrated by KUNZE and is marked by the narrow, lanceolate scales with the margins very shortly pseudociliate and by the obscure main veins. Very similar forms are found in most Malayan and some Polynesian islands; in some of them the scales are broadly ovate at base and tapering into a long acuminate apex, but all intermediates may be found.

To this f. *typica* belong *H. spicata* var. *novoguineensis* Rosenstock, *Hedwigia* 56: 353. 1915, and at least partly *H. spicata* var. *longipaleacea* v. A. v. R. Bull. Jard. Buit. VII: 19. 1912. The chief character ascribed to the former, the presence of scales at the base of the spike, is often met with in specimens from different countries. As to the specimens from New Caledonia listed below I refer the reader to my remarks under *H. revoluta* var. *planiuscula*.

Ceylon (THWAITES 1303 p.p., *Kew* = f. *longipaleacea*).

Malay Peninsula: Penang (C. CURTIS 613, Dr. King's collector 1597 *Si*, E. S. & G. HOSE 4846, *Kew*), Perak (RIDLEY s. n., *Si*).

Annam: Nhatrang (POILANE 3283, 3757 *RB*).

Sumatra LÖRZING 6056 = f. *longipaleacea*).

Lingga Arch (BÜNNEMEIJER 6809 *U*).

Java: some few specimens seen (f. inst. ZOLLINGER 1407, PALMER and BRYANT 89 *Cal*).

Borneo: Sarawak. Lundu (MjöBERG, Native coll. of Sarawak Mus. 16). Amboina (ROBINSON 1949).

Philippine Islands: Luzon (CUMING 92, MEYEN, LOHER 1169, 1208, 13913, Bur. Sci. 57, 1495, 19800, 32465, 33332, COPELAND 213, MERRILL 3912, ELMER 6967, 7668, 16206, 22286, RAMOS 640, TOPPING 1072, 1193, 1323, P. BARTSCH 135); Leyte (C. A. WENZEL 576); Mindanao (COPELAND 1519, ELMER 14214, Mrs. CLEMENS 715, 15644, C. M. WEBER 1490, *Kew*).

Papua (F. HELLWIG 363, BAMLER 60 = var. *novoguineensis* Ros., WERNER ed. ROSENSTOCK, Fil. N. Guin. exs. 14 = *H. rigidissima* Ros. Fedde, Rept 5: 371. 1908, not CHRIST; s. l. MACGREGOR).

Marianne Islands: Guam (GAUDICHAUD, ESCHSHOLTZ).

Pelew Isl. (LEDERMANN 14461, B. TETENS 38 RB).

Solomon Isl. (MILNE 564, *Kew*).

New Hebrides: Aneiteum (HERUS 69, MILNE 274, 347); Tanna (MILNE 458, *Kew*).

FIJI (BRACKENRIDGE, SEEMANN 726, E. DAMEL 41, VIEILLARD 4, H. E. PARKS 20177, 20254, CC).

Cook Isl.: Raratonga (CHEESEMAM 788, *Kew*).

New Caledonia (VIEILLARD 1588 p.p., BALANSA 3132, SCHLECHTER 15040, 15673, A. LE RAT s. n., FRANC 354 p.p., also ed. ROS. Fil. Nov. Cal. exs. 115 p.p., CRIES 452).

2. f. *graminifolia* (ROS.). (*H. spicata* var. *graminifolia* Rosenstock in Fedde Rept. 12: 530. 1913.)

Rhizome-scales from a broad ovate base abruptly contracted into an acuminate apex, rather long ciliate; leaf long and narrow, 20—30 cm. long by 4—5 mm. wide.

Papua (BAMLER 60, type, LEDERMANN 9720, F. HELLWIG 354, SCHLECHTER 17125, B).

3. f. *australiensis* n. f.

Rhizome-scales from a broad base gradually attenuate into an acuminate apex, strongly ciliate by long often curved cilia.

Queensland: Moreton Bay (HILL, B, *Kew*, *Le*).

4. f. *helocharidioides* n. f. (*Acrostichum spicatum* var. Baker, Ann. of Bot. 5: 113. 1892).

A dwarf form, of which I have seen two leaves only; they are thickly coriaceous, 7—9 cm. long, 5 mm. wide, the spike 1 cm. by 2 mm. wide. Scales as in the type.

New Hebrides, without exact locality (*Kew*).

*Acrostichum spicatum* var. *Schneideri* Bailey in Comp. Cat. 649, 849, fig. 613, a form with the fronds sometimes once or twice forked, is perhaps a monstrous form of f. *australiensis*. I have seen one leaf from Queensland: Nerang Creek (H. SCHNEIDER, RB), it lacks rhizome and is therefore indeterminable. According to BAILEY and DOMIN (Bibl. Bot. 85: 168) "*H. spicata*" is found in several localities in Queensland and the northern coast-region of New South Wales. It is very probable that other forms or even species than *H. mucronata* var. *australiensis* are included in DOMIN's records.

5. var. *nigropunctata* Hieron. ms. (pro specie).

?*H. spicata* var. *squamulifera* v. A. v. R. Bull. Jard. bot. Buitenzorg VII: 19. 1912.

Differs from the type by the distinct prominent main veins and by the usually very distinct, a little prominent blackish hydathodes of the free veinlets on the upper surface. Leaves 30 to 45 cm. long by 1 to 1.5 cm. wide, on stalks 3 to 5 cm. long, plane, spike 10 to 15 cm. long, 2 to 3 mm. broad.

Papua: Kaiserin-Augusta Fluss (LEDERMANN 13068, type, *B*, 9486, 12599 *B*)  
Dutch New Guinea s. l. (Wollaston-Expedition, Camp VI b, *Kew*).

Hieronymus considered this a distinct species, but the two characters mentioned above, by which it differs from *H. mucronata*, do not seem sufficient for its segregation, as otherwise it agrees with the type; forms with raised main-veins are met with in almost all species of the genus, and blackish hydathodes in the upper side are not rarely present in typical *H. mucronata*. HIERONYMUS was of opinion, and I think he was right, that v. A. v. R. mistook these hydathodes for scales, and his variety quoted above is presumably identical with var. *nigropunctata*; it was collected in New Guinea, near Tenem River (GJELLERUP 805, n. v.).

To this variety I refer a larger form from Celebes, which I name:

*forma latior*.

Leaves 2 to 3.5 cm. wide, the black hydathodes less distinct or quite absent. This form is exceedingly like *H. revoluta* var. *costulata*, but the scales different.

Celebes: Bolaang Mongondon, Modajag (W. KAUDERN, *CC*); s. l. (KORTHALS 109, *B*).

#### 7. *Hymenolepis Vaupelii* Hieron. ms. sp. nov.

Rhizome horizontally creeping, the scales dense, large, blackish-brown, ovate-acuminate and finely ciliate, equally clathrate throughout with black walls and large lumens. Leaves subapproximate, up to 60 cm. long by 2 cm. wide, broadly linear, rather shortly narrowed to both ends — the unwinged stipe very short (1—2 cm.) — coriaceous, yellowish-green, nigro-punctate above; midrib strong and prominent, furnished with some few minute clathrate hair-pointed scales beneath; veins faintly visible, no prominent main veins. Sterile portion of fertile frond shortly narrowed toward the spike, about 5 mm. broad and somewhat unequal-sided below the base of the spike, this 5 to 10 cm. long by 5 mm. wide, the edges at first revolute; sporangia covering the whole underside, mixed with very numerous peltate dark-brown paraphyses with thick cell-walls; even in older spikes the sporangia are partly hidden under the paraphyses.

Samoa: Savaii Island (VAUPEL 321, type, *B*, *Kew*); Kamingebiet des Vulkanes Maungaafi (K. u. L. RECHINGER 2 and 1978, *Vii*), s. l. (WHITMEE 190, *Kew*), POWELL 196, *Kew*.

This new species is chiefly characterized by the large ovate-acuminate scales which resemble those of *H. platyrhynchos* though less strongly ciliate, by the broadly linear, nigro-punctate leaves and the proportionally short

and broad spike; most peculiar is the dense mass of blackish clathrate paraphyses which until late perfectly cover the sporangia.

8. *Hymenolepis callifolia* Christ, Ann. Jard. bot. Buitenzorg II. 5: 128. 1905.

*Gymnopteris spicata* var. *latifrons* Bedd. Journ. of Bot. 1888: 6; Hdb. Suppl. 104.

*Hymenolepis spicata* var. *Bakhuizenii* v. A. v. R. Hdb. Suppl. corr. 59. 1917 (ex descr.).

Type from Dutch Borneo, HALLIER 632 (*Bog!*).

Rhizome short-creeping, the scales blackish, ovate and long acuminate, strongly spinescent ciliate; leaves tufted, often very large, the sterile

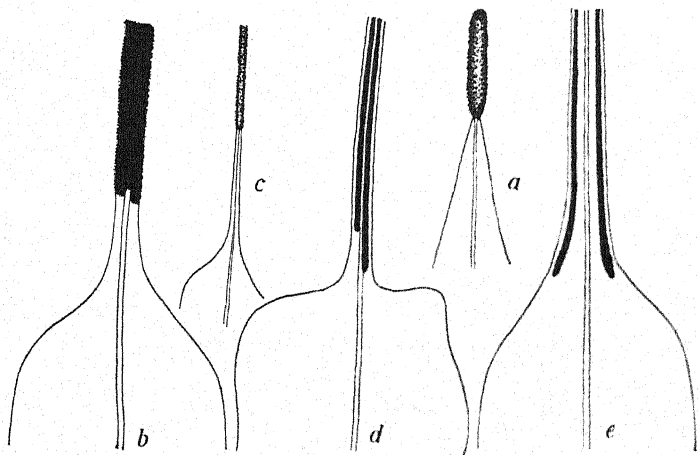


Fig. 1. a. *Hymenolepis mucronata*, b. *H. callifolia*, type, c. ditto, narrow form. d. *H. Henryi*, e. *H. annamensis*. Nat. zize.

portion 30 to 40 cm. long, 3 to 6 cm. broad, narrowed gradually toward the stipe (this 1—5 cm. long) shortly or sometimes abruptly and as a rule equally toward the spike, generally terminating in an obtuse or linear sterile, stipelike tip without constriction below the sori (text-fig. 1 b, c), surfaces naked, texture thinly papyraceous or subcoriaceous, the veins usually faintly visible, prominent main veins none. Spike up to 35 cm. long, 2 to 4 mm. broad, the edges involute, the whole underside covered with sporangia; receptacle about medial.

Borneo: Gunung Damus (HALLIER 632, *Bog*); Sarawak: Mt. Merinjak (Native collector of Sarawak Museum no. 110, *RB*, *CC*).

Natuna Island (A. H. EVERETT, *Kew*).

Malay Peninsula: Penang (C. CURTIS s. n., HOLTUM 19303, *Si*), Perak (SCORTECHINI s. n., *Le*, RIDLEY s. n., WRAY s. n., *Si*, King's collector 2147 *B*), Pahang: Telom (RIDLEY 13953, *Si*).

Java: Lawang, Tengger Mts. (MOUSSET 131 ed. ROSENSTOCK, Fil. Javæ exs. 115), Tjibodas (HJ. MÖLLER, S).

Timor (FR. NEWTON, *Kew*).

This is the largest species and when fully developed easily distinguished from *H. mucronata* by its size, but I fear that the smaller forms run gradually into typical *H. mucronata*. According to the short description the Javanese var. *Bakhuizenii* v. A. v. R. is this species or a form of it, and I suppose that *Acrostichum brachystachyum* Raciborski, Pteridoph. Buit. 51 is the same.

var. *paltonioides* var. nov.

Superficially like *H. annamensis* but scales not different from those of typical *callifolia*. Fertile portion not spike-like but downward rather gradually widened into the fertile blade; about 8 cm. long by 8 mm. wide; sporangia forming two marginal coenosori separated by a broad sterile central area.

Borneo: Sarawak, Baram (HAVILAND s. n. *Kew*), s. loc. (MACLEAY, *Kew*).

9. *Hymenolepis Henryi* Hieron.ms. sp. nov. — Text-figure 1 d.

Rhizome short-creeping, the scales blackish, clathrate, with very thick cell-walls, from a broad roundish base narrowed into a long, almost hairlike apex, short ciliate. Leaves densely tufted, subsessile (unwinged stalk 1 to 2 mm. long), thinly coriaceous, pale-green 15 to 20 cm. long 2 to 4.5 cm. broad, shortly narrowed toward the spike or often suddenly contracted, sometimes equally on both sides but usually one side gradually the other suddenly contracted, truncate; surfaces naked, the veins hidden or faintly visible, no prominent main-veins. Spike 5 to 15 cm. long, 1 to 4 mm. broad, without constriction at base, the margins recurved; sporangia borne on linear receptacles close to the midrib, rarely covering the whole underside but leaving the margins and as a rule also the midrib uncovered; the receptacles generally reach the base of the contracted portion of the blade, sometimes extending into the broad not contracted portion. Paraphyses numerous with thick black walls.

Type from Yunnan l. HENRY no. 11461 A (*B!*).

HIERONYMUS referred the specimens in Berlin from Himalaya-Yunnan to two different species, and it must be granted that the specimens from Yunnan look very distinct, being thin-leaved, elliptical in outline, 4 cm. wide at the middle, but some of the specimens from Khasia Mts., referred by HIERONYMUS to another undescribed species, are very nearly the same, though on the other hand scarcely distinguishable from other specimens from the same mountains, which are much smaller and have the sterile blade more gradually narrowed into the spike. In scale characters all specimens are alike and I consider them all as belonging to one somewhat variable species. Jerdon's specimen from Sikkim differs from the others by the main veins being distinct and somewhat raised beneath, a variation met with in most other species.

*H. Henryi* is closely related to *H. callifolia*; it differs by its almost hair-pointed, short-ciliate scales, subsessile leaves, shorter spike and especially by the receptacles running close to the midrib. The truncate apex of the sterile blade, a prominent feature of most leaves, is no stable character.

Yunnan: Szemao (HENRY 11461 A, B, B, 11461 C, B, Le, Kew, W).

North-India: Assam (HOOKER fil. & THOMSON, GRIFFITH, G. MANN, C. B. CLARKE 45931, Kew); Sikkim (CLARKE 25086 Le, 25241 Kew, Dr. JERDON, GAMBLE 7701, 10339).

Siam: On Tong Jâi(?) (KERR 8873, Kew), Kao Saiming, Krát (KERR 9377, Kew).

10. *Hymenolepis annamensis* sp. nov. — Text-figure 1 e.

Rhizome short-creeping, the scales similar to those of *H. Henryi*, the roots (of the type-specimen) forming a very large "Wurzelschwamm". Leaves tufted, the unwinged stipe strong, 2 to 3 cm. long, the sterile blade 25 to 35 cm. long, 4 to 5 cm. wide, coriaceous, naked, the veins scarcely or not at all visible, the upperside nigro-punctate, shortly and usually more or less unequally narrowed into the apical fertile portion, which is not spikelike, but from a broader base gradually tapering toward the apex, up to 25 cm. long, 1 cm. wide at base. Sporangia borne on distinct linear receptacles near the margin, leaving the middle part of the underside uncovered.

Annam: Col des Nuages près Tourane, 1100 m. alt. (POILANE 8010, type, P); Lao (POILANE 12210, P); massif de Đông Tri (POILANE 11001, P).

This new species is no doubt the most remarkable of all but really closely related to *H. Henryi*, from which it chiefly differs by the broad tapering contracted fertile apical portion with submarginal distinct coenosori. In POILANE 11001 the sori are medial because the "spike" is much narrower than in the type, but really they are placed just as near to the edge as in the other specimens and at least not close to the midrib as in *H. Henryi*, which species the said specimen resembles very closely as to all other characters. The species is an excellent example of the close relationship between *Lemmaphyllum* § *Pseudovittaria* and *Hymenolepis*. As a matter of fact the contracted fertile portion is quite like a fertile frond of *Lemmaphyllum sinense*, the position and whole aspect of the coenosori being the same.

11. *Hymenolepis platyrhynchos* (J. Sm.) Kunze, Farrnkr. 1: 102, Hook.

Ic. pl. pl. 994; C. Chr. Ind. 356 with syn.

*Macroplethus platyrhynchos* Pr. Epim. 142.

Type from Luzon: Majajai Mt., CUMING 196 (cotypes in B, Kew, Wi).

A most distinct species, in general habit resembling *H. validinervis* but the scales like those of *H. mucronata*; they are long-acuminate from a broad base, clathrate to the edge and ciliate by rather long but fine cilia. Leaves short-stalked, up to 50 cm. long, 4—6 cm. broad, shortly attenuate upwards, main-veins not prominent, the spike 4—8 cm. long, often 1—1.5

cm. broad, the sporangia not covering the whole underside but leaving an uncovered edge sometimes 3 mm. broad on each side; in young spikes the sterile margins are recurved, perfectly covering the sporangia; paraphyses mostly small, claviform.

The genus *Macroplethus* Presl was founded on this species; the author supposed that the sporangia are borne on the midrib and the parenchyma on both sides, thus forming a single central sorus. In this PRESL was wrong; the sporangia are borne on two linear receptacles close to the midrib as in other species of *Hymenolepis*.

The species seems to be endemic in the Philippines, where it according to COPELAND is found on high mountains throughout. This cannot be denied but it is remarkable that the rather numerous specimens examined by me were all gathered in Luzon. The specimens from Mindanao belong to *H. glauca*. It has been recorded for Celebes, but all specimens from that island referred to it and seen by me belong to *H. validinervis* var. *celebica*.

Luzon: Tayabas (CUMING 196, FOXWORTHY 2463, ELMER 7993, 9043), Arayat (LOHER 817), Mt. Data (COPELAND 1865, Mrs. CLEMENS 16300), Benguet (MERRILL 689, BARNES 960), Haight's Place (TOPPING 1178), Mt. St. Tomas (ELMER 5802, WILLIAMS 1570 bis, TOPPING 1211. A. & V. Kryshstofovich, *Le*, McCURE 16058), Mt. Maquilang (ELMER 17626), Mt. Caua (RAMOS 38083), Pauai (MCGREGOR 8451, SANTOS 32039), Mt. Pinatubo (Mrs. CLEMENS 17325, ELMER 22199), Mt. Pulog (COPELAND: Pteridoph. Phil. exsic. 132, CURRAN 16290), Mt. Polis (MCGREGOR 19685).

The systematic position of *Hymenolepis* is quite clear. GOEBEL has examined "*H. spicata*" (i.e. *H. revoluta*) in detail (1926, p. 108—114), and his studies fully confirm the conclusion, at which I have arrived after examination of a very comprehensive material, that the genus is a specialized group of the *Pleopeltis*-complex. The peltate paraphyses show that its nearest relatives must be found among the *Lepisorus*-group of *Pleopeltis*. GOEBEL compared *H. revoluta* with the common Malayan *Polypodium* (*Pleopeltis*) *revolutum* C. Chr. and found them agreeing in essential characters (p. 113) and this statement is true. On the other hand *Hymenolepis* comes very near to *Leptochilus* Klf. (*Leptochilus* § *Euleptochilus* C. Chr. Ind. XXVI), and Beddome united it with this genus, by him called *Gymnopteris*. *Leptochilus* is another group of polypodioid ferns derived from *Pleopeltis*. It has proceeded farther than *Hymenolepis* toward dimorphism and acrostichoid arrangement of the sporangia and should be placed immediately after *Hymenolepis*.

My studies of all known species have shown, moreover, that *Hymenolepis* and *Lemmaphyllum* are closely related. Both genera

are derived from the same group of *Pleopeltis*, each representing a special line of development. The section *Pseudovittaria* of *Lemmaphyllum* is the intermediate group between *Eu-Lemmaphyllum* and *Hymenolepis*. *L. abbreviatum* is naturally placed in the latter as well as in the former genus, *L. sinense* has no doubt a very near ally in *H. annamensis* (see above) and *L. novoguineense* is equally closely related to *H. squamata*, which species together with *H. validinervis* by their wide-creeping rhizome and large, glossy, thin-scales differ greatly from the other species.

### Paltonium Presl.

Type-species: *Pteris lanceolata* L. A monotypic American genus.

**Paltonium lanceolatum** (L.) Pr. Epim. 156. 1841; C. Chr. Ind. 477 with synonyms.

Type from Hispaniola, based on Plumier, Fil. pl. 132.

Widely spread in the West Indian Islands, found in the four large islands and in most of the Lesser Antilles and besides in Florida, Central America (Guatemala, Honduras) and in French Guiana.

A well-known and often described species, and I find it unnecessary to mention it here in detail. It seems to be a fairly constant species, but having not had a large material for examination I dare not say with certainty if it is possible to segregate more or less distinct geographical forms or varieties. I shall confine myself to discussing its relationship.

*P. lanceolatum* is superficially very like *Lemmaphyllum sinense* but in my opinion it is genetically and subsequently also generically different from it. It differs chiefly by the lack of peltate scales (paraphyses) among the sporangia and on the underside, and further by the tomentose roots of the short-creeping rhizome as a rule forming a "Wurzelschwamm" as in *Hymenolepis*. In most other characters it agrees closely with *Lemmaphyllum* § *Pseudovittaria* and systematically the genus must naturally be placed in the same narrow group of "drymoglossoid" ferns derived from polypodioid ancestors. The difficulty of the right understanding of its relationship is found in the fact that no species of American *Polypodia* can be regarded as its near relative. Among American ferns it is a very isolated type, and it seems necessary to fall back upon the hypothesis of a tertiary subtropical or tropical fern-flora widely spread over both northern hemispheres, the descendents of which are now found partly in Asia partly in America, if we will try to understand the phyletical relation between *Paltonium* and the Asiatic genera. The case is by no means unique in the plant-world and we also find other examples among the ferns f. inst. *Cochlidium* and *Scleroglossum* mentioned above, *Phyllitis Schaffneri* in Mexico and *Ph. Delavayi* in Yunnan, the two species of *Cyclophorus* in the South American Andes and several others.

### Phylogeny and mutual relationship of *Lemmaphyllum*, *Drymotaenium*, *Hymenolepis* and *Paltonium*.

Having now given a review of the known species of these four genera I shall briefly summarize my results concerning their natural systematic position.

The three first-named genera agree in several important characters:— 1) creeping rhizome, 2) stipe articulated to rhizome, 3) entire fronds, 4) reticulate veins without distinct strong main veins and with free included veinlets in the areoles, 5) linear receptacles, 6) peltate paraphyses, 7) bilateral spores, 8) absence of simple hairs. The scales are moreover of the same type. All these characters, the fifth: linear receptacles and coenosori only excepted they have in common with the group *Lepisorus* J. Sm. (*Clathropeltis* Kuhn) of *Polypodium* subgenus *Pleopeltis*, and it is beyond doubt that the three genera are so intimately related to that group that it would be quite natural to reduce them to sections of it, especially because the character: linear coenosori is found to be an unstable one, at least in *Lemmaphyllum*. According to my considerations above, I have preferred to segregate these genera from *Polypodium* regarding them as comparatively new offshoots from the *Lepisorus*-complex.

Whether now these three genera all belong to a single evolutionary series with a common ancestor within *Lepisorus* and thus representing a narrow group of closely related genera, or each represents a special branch originating from different ancestors, is a question that cannot be answered on the basis of facts, but only on the basis of more or less well founded speculative considerations. Both hypotheses may be supported by equally good reasons.

As often mentioned above several of the species dealt with show so close a resemblance to certain species of *Polypodium* sect. *Lepisorus* that it seems probable, that each is a recent derivative from its polypodioid mother-species or rather from an older form which during the course of evolution has been split up into one polypodioid and one "drymoglossoid" daughter-species. Pairs of such sister-species are f. inst.:

<i>Polypodium drymoglossoides</i>	— <i>Lemmaphyllum microphyllum</i> .
<i>P. subrostratum</i>	— <i>L. carnosum</i>
<i>P. lineare</i>	— <i>L. sinense</i>
<i>P. eilophyllum</i>	— <i>Drymotaenium Miyoshianum</i>

A fifth pair is perhaps *Polypodium revolutum* and *Hymenolepis revoluta*, but here the relationship is less evident. If this hypothesis is right the three genera include species which appear as twigs from the *Lepisorus*-branch of the big *Polypodium*-branch of *Polypodiaceæ*.

The other hypothesis seems more difficult to defend. The differences between the species of *Eu-Lemmaphyllum* and *Hymenolepis* is so striking that it appears to be quite unnatural to place them in the same evolutionary series. The large gap hitherto found between the two genera is, however, now partly filled out by the discovery of some of the more interesting species described above and the species: *Lemmaphyllum microphyllum*, *L. carnosum*, *L. abbreviatum*, *L. sinense*, *Hymenolepis annamensis*, *H. Henryi* and *H. mucronata* form a row of forms that very gradually run into each another. Thus it becomes possible that *Hymenolepis* is derived from *Lemmaphyllum*-like ancestors resembling *L. sinense* and through forms like the present *L. abbreviatum* and *H. annamensis* has reached the common *Hymenolepis*-type with much contracted spikelike fertile apical portion. The next step is reached by *Leptochilus* (*L. decurrens*, *L. axillaris* and other species) with the whole fertile leaf contracted and acrostichoid arrangement of the sporangia; the lack of peltate paraphyses may be due to the expansion of the fertile epidermal tissue.

Within *Hymenolepis* we find two species, *H. validinervis* and *H. squamata*, which by their wide-creeping rhizome and large, thin, glossy scales differ greatly from the other species of the group. These species are very closely related to *Lemmaphyllum novoguineense*, which species should perhaps be referred to *Hymenolepis* although it shows all characters of *Lemmaphyllum* §*Pseudovittaria*. These three species give us another example of the close relationship between the two genera, but in this case I am inclined to believe that *L. novoguineense* is a derivative of *Hymenolepis*, which through retrogressive evolution has obtained the characters of the nearest ancestors of that genus; of course, new discoveries in that eldorado of ferns, New Guinea, may show, perhaps, that there exist related species of true *Polypodia*, between which and the two species of *Hymenolepis*, *L. novoguineense* is a connecting link.

Even if it is possible thus to place the species of *Lemmaphyllum* and *Hymenolepis* in a single evolutionary series it is not

easily seen how *Drymotaenium* should be placed in the same series. It may be an offshoot of *Pseudovittaria* but more probable it has its offspring in another group of *Lepisorus* and gives us good reasons for considering the first mentioned hypothesis the best founded. I am of opinion that both hypotheses are partly right. Not all species of the three genera can be arranged in a single series; they have developed along two or three different lines, all from *Lepisorus*-like ancestors.

The fourth genus, *Paltonium*, agrees with the three others in all characters mentioned in p. 71, the sixth only excepted, lacking peltate paraphyses. Because of this important difference together with its quite different geographical area I consider it a phyletically remote member of the same narrow group of genera; concerning its probable relationship I refer the reader to my remarks in p. 70.

The three following genera, which are here segregated from the old genus *Drymoglossum*, are so different from the four genera dealt with above that they cannot naturally be placed in the same narrow group.

#### ***Myuropteris* genus novum.**

Rhizome wide-creeping with fuscous clathrate scales. Leaves extremely dimorphous, quite glabrous and naked, the sterile ones on shorter stalks, ovate, obtuse, entire, not carinose, the fertile ones on long slender stalks, narrowly linear. Main veins indistinct, scarcely stronger than the others, which form oblique areoles that nearly all, also the costal ones, include a free veinlet running toward the midrib. Sporangia borne on a linear receptacle near the midrib, superficial; paraphyses none.

Type-species: *Drymoglossum cordatum* Christ.

This new genus differs from *Lemmaphyllum* mainly by lacking peltate paraphyses and by another habit and texture. In most technical characters it agrees with *Pycnoloma*, from which it differs in venation, colour, texture, clathrate scales etc.

***Myuropteris cordata* (Christ) C. Chr. comb. nov. — Plate IX fig. 1—2, X fig. 3.**

*Drymoglossum cordatum* Christ in Lecomte, Not syst. 1: 375. 1911.

*Campium dilatatum* Copeland, Phil. Journ. Sci. 37: 347, pl. 4, fig. 2. 1928.

Scales of the wide-creeping rhizome clathrate from an ovate peltate base, rather suddenly narrowed into a long subulate apex, dark-brown, very faintly toothed. Stalks of sterile leaves slender, 3 to 10 cm. long, the blade ovate, 2.5 to 4 cm. long, 1 to 2.5 cm. wide, bluntly rounded or subacute at the tip, suddenly narrowed at base and shortly decurrent, the larger subcordate, dark-green and rather thin in texture with thin entire margins, quite glabrous and naked. Midrib-slender, raised on both sides, not reaching the apex; main-veins none; veins distinct when held against the light, in larger leaves forming about 4 rows of oblong irregular areoles between the midrib and edge, several of which, also the costular ones, include long simple free veinlets that all run toward the midrib. Stalk of fertile leaves thread-fine, up to 20 cm. long, the blade linear, 4 to 6 cm. long, 1 to 2 mm. broad, flat, the apex bluntly rounded. Coenosori running close to the midrib from the base of the lamina to about 5 mm. from the tip, superficial.

Annam: Ba Long, Hou mê, on rocks along a stream, 20—30 m. above the sea (CADIÈRE 158, *RB'* type).

Hainan (ERYL SMITH 1446, t. COPELAND).

Relationship of *Myuropteris*. I do not know at present any species of *Polypodium*, to which *M. cordata* may be properly compared. Although it has many important characters in common with *Pycnoloma* it is certainly not a near phyletic relative of that genus and its allies among polypodioid ferns. I find, however, that it comes very near to some species of *Leptochilus*, this taken in a narrow sense comprising the section *Euleptochilus* Ind. Fil. only. It closely resembles the species of the section *Dendroglossa* Pr., f. inst. *L. minor* Fée from Luzon and *L. minutulus* Fée from Assam, in scale-structure, colour and especially in venation (compare pl. 10 fig. 3 with HOOKER's illustration of *L. minor*, 2. Cent. pl. 78); also the narrow fertile leaf of *L. axillaris* Klf. resembles our species. This differs from *Leptochilus* by its distinct drymoglossoid coenosori, still it must be confessed that it is often difficult to state that f. inst. *Leptochilus axillaris* is an acrostichoid, not a drymoglossoid species. I believe that the species of *Leptochilus* mentioned and some few others together with *Myuropteris* belong to the same phylum, which thus includes drymoglossoid as well as acrostichoid species, while polypodioid forms are unknown, at least to me. Nevertheless it can scarcely be doubted that *Myuropteris* is a drymoglossoid genus derived from some polypodioid ancestors<sup>1)</sup>.

<sup>1)</sup> This paper was partly printed when I received COPELAND's large monograph of *Leptochilus* and related genera (Phil. Journ. Sci. 37, Dec. 1928),

**Pycnoloma** genus novum.

Rhizome wide-creeping with peltate, lanceolate entire or faintly toothed scales with thin walls. Leaves extremely dimorphous, entire, quite glabrous and naked, mostly thick and coriaceous but apparently not carnose (not wrinkled when dried). Sterile leaves roundish or ovate with a rounded or subtruncate base, the edge much thickened, the stipe 2—4 cm. long. Veins anastomosing, forming 3—4 rows of areoles between the midrib and edge, most of which, the costal ones excepted with one or two free included veinlets that run toward the edge. Fertile leaves on much longer stalks, linear, 1 to 3 mm. broad, obtuse. Sporangia borne on linear receptacles parallel to and near the midrib, often sunk in a deep groove between the thick "midrib" and the recurved margins. Paraphyses none. Spores bilateral, minutely reticulate and sparsely and shortly echinate.

Type-species: *Drymoglossum rigidum* Hook.

In general habit the three species placed in this genus resemble *Eulemmaphyllum*, but evidently they are very remotely related to that group. Besides some features, difficult to describe but essential to the trained student, the lack of peltate paraphyses and clathrate scales of the underside, in my opinion a most important character, fully justify the establishment of a new genus. Unfortunately this cannot be regarded as a natural unit of closely allied forms, because the three species are rather different,

in which he segregates *Campium* Presl from *Leptochilus* as a genus, making two sections *Dendroglossa* and *Heteroneuron*, which I should prefer to maintain as genera. He describes a new species of § *Dendroglossa* from Hainan (*Campium dilatatum*) which is beyond doubt identical with *Myuropteris cordata* (compare his pl. 4 fig. 2 with my pl. X fig. 3). From my remarks above it is seen that I agree with COPELAND that *Dendroglossa* and *Myuropteris* are extremely closely related and it is a matter of convenience only if we shall recognize one or two genera, one drymoglossoid and one acrostichoid. From examination of dried material only it is in most cases nearly impossible to ascertain whether the sporangia are borne on a linear receptacle only or scattered over the surface. COPELAND finds the transition from "*Polypodium*" to *Campium* very completely bridged through some species of *Selliguea* with much contracted fertile fronds (f. inst. *Pol. fluviatile* Laut.). In this I do not agree with him; in all species of *Selliguea*, also in *P. fluviatile*, the coenosori are parallel to the main veins forming an acute angle to the costa, not longitudinal and crossing the main veins as in all drymoglossoid genera.

representing two types, which very well could be treated as genera. I prefer, however, to place them in the same genus, dividing this into two sections:—

1. **Eupycnoloma**. No distinct main veins; edge of sterile leaf without notches. — Hereto *P. rigidum* and *P. metacoelum*.
2. **Pleuripteris** subgen. nov. Main veins strong and prominent nearly to the thick margin, this with a notch between each two main veins. — Hereto *P. murudense*.

My reasons for this treatment are to be found below.

### 1. Eupycnoloma.

1. **Pycnoloma rigidum** (Hook.) C. Chr. comb. nov. — Plate VIII fig. 1—2, X fig. 1.

*Drymoglossum rigidum* Hooker, Ic. plant. pl. 996 (= Cent. Ferns pl. 96), C. Chr. Index.

*Schizolepton rigidum* Moore Ind. XXX. 1857.

*Taenitis rigida* Copeland, Sarawak Mus. Journ. 2: 329. 1917.

*Drymoglossum tetragonum* v. A. v. R. Bull. Jard. bot. Buitenzorg II. no. XXVIII; 21 pl. III. 1918.

Type from Sarawak l. THOS. LOBB (*Kew!*).

Rhizome-scales lanceolate, 2 to 3 mm. long, peltate, long-acuminate or nearly hair-pointed, dark-brown or blackish in the middle, the edges paler and with age, like the slender tip, whitish, minutely dentate toward the base or subentire, the cells narrow with not very thick walls. Stalks of sterile leaves 1 to 4 cm. long, stiff, the blade ovate or elliptical, 2.5 to 3 cm. long, 1.5 to 2 cm. wide, very thick and coriaceous, yellowish green, glossy, the margins thickened, fully entire without notches; midrib strong, quadrangular and prominent on the underside below but becoming obscure toward the apex. Sometimes the sterile leaves approach the fertile ones, and may be partly fertile (Plate VIII fig. 1). All veins immersed and invisible, rather irregularly anastomosing, forming about 3 rows of areoles between midrib and edge, with or without free included veinlets, the costal ones without such (pl. X fig. 1). Stalks of fertile leaves mostly 5 to 6 cm. long, the lamina linear, 8 to 10 cm. long by 2 to 3 mm. wide, midrib very strong and raised beneath, quadrangular, extending to short of the spoon-shaped apex; upperside with a narrow furrow at the middle, the edges bent backwards under a right angle and a cross-section of the blade is, therefore, nearly quadratic (fig. 2). Coenosori at the bottom of the deep groove formed by the recurved margins and the raised midrib (rightly the costal parenchyma); in the partly fertile leaves (see pl. VIII) it is seen that the receptacle runs close to the midrib in the inner corner of the groove.

Borneo: Sarawak (THOS. LOBB, *Kew*; WALLACE, *Wi*, Native collector of the Sarawak Museum no. 223, *CC*, *RB*), Long Sele (SCHLECHTER, *B*). Dutch Borneo (TEUSCHER, *Bog.*, type of *D. tetragonum* v. A. v. R.).

The systematic position of *Dr. rigidum* has been problematical since the species was described by HOOKER in 1854, and several writers have expressed their doubt as to its alliance with the other species of *Drymoglossum*, thus JOHN SMITH (Hist. Fil. p. 118) and GOEBEL (l. c., see above p. 40). No one but TH. MOORE and, in recent time, COPELAND, has, however, ventured to refer it to another genus, because the species was apparently known to almost all pteridologists from HOOKER's illustration of the type specimen only. All considerations were based upon that illustration and HOOKER's statement that the veins are reticulated without free included veinlets. MOORE (Ind. Fil. p. XXX), therefore, referred the species to *Schizolepton* Fée, the type-species of which is *Schizoloma cordatum* Gaud., a species related to *Taenitis*, I think, but not at all to *Dr. rigidum*. A similar error was committed some years ago by COPELAND, who tentatively referred *Dr. rigidum* to *Taenitis* (Sarawak Mus. Journ. 2: 329. 1917), and VAN ROSENBURGH has described a new species believed to be different from *Dr. rigidum* by having free included veinlets. HOOKER's illustration of the venation is, however, incorrect and misleading; my figure (pl. X fig. 1) shows the venation of a typical sterile leaf.

*P. rigidum* is evidently a very rare fern that remained unknown to almost all pteridologists. The beautiful set of specimens gathered by the collectors of the Sarawak Museum agree perfectly with the type, of which HOOKER has given an excellent illustration as far as the habit is concerned. *Dr. tetragonum* v. A. v. R. is identical with *P. rigidum*. The only difference appears to be the smaller almost sessile sterile leaves, but similar leaves occur in some of my specimens. The differences pointed out by v. A. v. R. do not exist because of the misleading analytical figures given by HOOKER.

***Pycnoloma metacoelum*** (v. A. v. R.) C. Chr. comb. nov. — Plate VIII fig. 3, IX fig. 2, X fig. 2.

*Drymoglossum metacoelum* v. A. v. R. Bull. Jard. bot. Buitenzorg II no. XXVIII: 21 pl. II. 1918.

Type from Dutch Borneo, HALLIER no. 2942. (*Bog*).

Closely allied to *P. rigidum*, but sterile leaves somewhat smaller and not nearly so thick, brown or grayish-brown when dried, the raised midrib terete not quadrangular, and principal lateral veins more distinct and almost straight, the areoles nearly all (the costular ones excepted) with free included veinlets. Stalks of the fertile leaves very slender and long (up to 15 cm.), the blade linear, 5 to 10 cm. long by 1 to 2 mm. wide, the midrib and the edges not nearly as thick as in *P. rigidum*; the edges at first rectangularly reflexed and the raised midrib forming a groove, at the bottom of which the receptacles are found, at least more or less flat, expanded.

Dutch Borneo: Liang Gagang (HALLIER no. 2942, *Bog*, *L*); Bukit Tilung (HANS WINKLER 1499).

Malay Peninsula: Province of Wellesley, Karangan Kulim (CURTIS?  
s. n. Kew, Mrs. HANIFF, *S<sup>i</sup>*).

## 2. *Pleuripteris*.

*Pycnoloma murudense* sp. nov. — Plate VIII fig. 4—6, plate X fig. 4.

Rhizome slender, about 1 mm. thick, wide-creeping and somewhat branched, subglaucous under the scales which are light-rufous, lanceolate, thin, entire and finely acuminate, nearly hair-pointed. Stipe of sterile leaves threadfine, 3—4 cm. long, often twisted, straw-coloured, sulcate above, furnished with some few linear light-coloured deciduous scales, the blade ovate, 1.5—2.5 cm. long by 1—1.5 cm. broad, broadly cuneate or subtruncate and shortly decurrent at base, the apex bluntly rounded, the edges distinctly crenate, thickened, with notches between the main veins; texture papyraceous, colour glaucous-green; main veins raised on both sides and distinct to the edge, cross-veins raised at base, the smaller ones forming 2—3 rows of areoles between the main-veins, the areoles mostly with one or two free veinlets running toward the margin (pl. X fig. 4). Stipe of fertile leaf 12 cm. long, the blade linear, 7.5 cm. long by 1 mm. wide, obtuse, the edges thickened and recurved, the midrib much raised below, the obscure veins forming a row of oblong costular areoles as far as seen without free veinlets, partly sclerenchymatic (pl. VIII fig. 5). Sporangia filling the whole space between midrib and edge but apparently all borne on an indistinct linear receptacle near the midrib, not immersed.

Borneo: Sarawak, Mt. Murud, leg. Dr. E. Mjöberg 1923 (C. Chr.).

The fertile leaf closely resembles that of *P. metacoelum*, but the sterile one is considerably different by its strong, raised main veins and notched margins, thus in important characters agreeing with the following genus *Grammatopteridium*, to which I at first referred the species, believing that the characteristic notches of the margins were to be found only in species with strong main veins. These two characters are found together in not a few species of *Polypodium*, and J. SMITH based upon them a new genus, *Phymatopsis* (Hist. Fil. 104). I find, however, that notched margins may occur in leaves with quite invisible main veins, thus in *Pol. pyrolifolium* Goldm. (*P. nummularium* (Pr.) Mett., cf. FÉE, 6. mém. pl. 5 fig. 3 (venation too schematic), METT. Pol. pl. I fig. 44, 45, v. A. v. R. Bull. Dépt. agric. Ind. néerl. no. XXVII pl. II) and in a new species, *P. Hagerupii* described below<sup>1)</sup>. *P. nummularium* is the type of the genus *Crypsinus* Presl, Epim. 123. A comparison of my figure (pl. 8 fig. 5) with the enlarged figures of

<sup>1)</sup> *Polypodium Hagerupii* sp. nov. — Plate IX fig. 3.

Rhizome wide-creeping, clothed with light-brown, thin, peltate, lanceolate-acuminate, minutely dentate scales. Leaves extremely dimorphous, the sterile ones ovate, ovate-oblong or elliptic, thickly coriaceous, glabrous, the stipe 0.5—1 cm., the blade 2—2.5 cm. long by 1—1.5 cm. wide, bluntly rounded at both ends or the base truncate, the margins thickened and recurved with distinct notches; midrib raised in the lower  $\frac{2}{3}$  beneath, all veins invisible.

the fertile leaf of PRESL's species on the plates quoted shows a close resemblance between the two species as to the venation of the fertile leaf. We thus find important characters variously combined in different species and it, therefore, seems, best to refer at least some of the species of J. SMITH's *Phymatopsis* to *Crypsinus* Pr. and *Pleuripteris* to *Pycnoloma*. In general habit *Pycn. murudense* agrees far better with the other species of the genus than with *Grammatopteridium*. It may be considered a drymoglossoid derivative of *Crypsinus* § *Phymatopsis*. It is evidently nearly related to *Pol. rhynchophyllum* Hook., agreeing closely with it in texture and venation, still the shape of the sterile leaves is different. Immediately related to our species is certainly *Pleopeltis pseudo-acrostichum* v. A. v. R., Bull. Jard. Buitenzorg II. s. XXVIII: 36 pl. V, 1918, from Sumatra, which judging from the author's plate only differ from *P. murudense* by the shorter and broader flat, fertile leaf with interrupted sori; after all it seems to be another species of *Pleuripteris*. A third allied species is *Polypodium costulatum* Baker, Journ. Bot. 1880: 215, from Sumatra (BECCARI 446, Firenze! Kew! Bog!) excellently illustrated by v. A. v. R. Bull. Dépt. Agric. Ind. Néerl. no. XXVII pl. 4; it is not identical with *Acrostichum costulatum* Cesati as supposed by BAKER, as CESATI's species belongs to *Grammatopteridium*. From all these and other species of *Polypodium* § *Phymatopsis* *Pycnoloma murudense* differs by the distinctly drymoglossoid fertile leaf.

Relationship of *Pycnoloma*. As shown above *P. murudense* is certainly a drymoglossoid derivative of the polypodioid group *Crypsinus* or *Phymatopsis*. The phylogeny of *Eupycnoloma* is more obscure. I do not know any species of *Polypodium*, which may be considered immediate polypodioid allies of *Pycnoloma rigidum* and *P. metacoelum*. *Polypodium Hagerupii* described above is certainly extremely like the two species of *Pycnoloma* but combining the characters of *Eupycnoloma* and *Pleuripteris*. If we regard *P. Hagerupii* as a representative of a specialized polypodioid offshoot of *Phymatopsis*, it seems equally justified to

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Stipe of the fertile leaf slender, 5—6 cm. long, sulcate above, the blade 4—5 cm. long, reduced nearly to the midrib which is carinate beneath, sulcate above and flanked by a very narrow thick parenchyma, on which the roundish or oblong, superficial sori are borne.:

Sumatra: Toba, leg. O. HAGERUP 1917 (CC).

A smaller species than *P. costulatum* Bak. and *P. pyrolifolium* Goldm., from which it differs by the much more reduced fertile leaf, from the former further by the wholly invisible main veins; from *P. Bakeri* Luer. (cf. v. A. v. R. Bull. Dépt. agric. Ind. néerl. XXVII pl. I. 1909) and *Pleopeltis pseudo-lateralis* v. A. v. R. Bull. Jard. Buitenzorg. II no. XXVIII 36, pl. VI. 1918, it differs by another shape of the sterile leaves, which very closely resemble those of *Pycnoloma metacoelum* though different by the notched margins.

consider *Eupycnoloma* a corresponding offshoot of *Pleuripteris*. Thus *Pycnoloma* is believed to be a drymoglossoid branched twig of the larger *Phymatopsis*-branch of the polypodioid ferns.

### **Grammatopteridium v. A. v. R.**

Nova Guinea 14: 24. 1924.

*Grammatopteris* v. A. v. R. Bull. Jard. bot. Buitenzorg III. 4: 318. 1922 (not Renault).

This genus agrees with *Pycnoloma* § *Pleuripteris* in the strong, straight and raised main veins of the sterile leaves, the thick margins of which are remotely crenate-serrulate by a low notch between each two main veins. It differs from *Pycnoloma* especially by the shape of the sterile leaves, which are much larger, lanceolate-acute or ovate-acuminate, and by the much more complicated venation, the veins forming a network of areoles with or without free included veinlets between each two cross-veins. Fertile leaves narrowly linear, the continuous coenosori at first more or less deeply immersed.

Type-species: *Drymoglossum Brooksii* v. A. v. R.

To this genus I refer two closely related species; a third species, *Gr. pseudodrymoglossum* v. A. v. R., unknown to me, may be generically different.

#### **1. Grammatopteridium costulatum (Cesati) C. Chr. comb. nov.**

*Acrostichum costulatum* Cesati, Rend. Acad. Napoli 16: 27, 30. 1877.

*Polypodium iboense* Brause, Engler's Bot. Jahrb. 49: 50 f. 3 B (sori interrupted). 1912.

Type from New Guinea: Ansus, l. BECCARI no. 12644 (Herb. Ist. bot. Firenze!).

Scales of the wide-creeping, subcretaceous rhizome fuscous brown, rather thin, lanceolate, finely acuminate, minutely dentate or subentire. Stipes of the sterile leaves 2—5 cm. long, brown, sulcate above, the blade ovate, 7—8 cm. long. 3—3.5 cm. broad, rounded-cuneate below and shortly decurrent at base, the apex obtuse or subacute, or lanceolate, 10—15 cm. long, 1.5—3 cm. wide, long acuminate, thickly coriaceous, somewhat glossy, quite glabrous, the thickened margins narrowly revolute and with a low notch between each two main veins, these oblique, distinct to the edge and prominent beneath; other veins invisible. Stipe of the fertile leaf 5—10 cm. long, the fertile portion 10—20 cm. by 3 mm. wide, covered with sporangia; these borne on linear subcostal superficial receptacles; edges of the mature fertile leaf curved upwards (cf. pl. VI fig. 13).

Besides the type-specimen I have examined a beautiful lot of specimens from Papua in Herb. Berol., l. SCHLECHTER (no. 16861, 17106, 19017 = *P. iboense* Brause, which is quite identical with the type) and LEDERMANN: Etappenberg (no. 9580, deviating a little by the narrower, lanceolate and acuminate leaves). More doubtful is a small specimen from Hunstein-

spitze (LEDERMANN 11215, *B*), figured on plate VIII fig. 7. To the type I further refer a specimen from Buru Island, Moluccas (TOXOPEUS 344, *Bog*).

Somewhat different are the following forms, which I refer to *G. costulatum* as varieties.

var. **Brooksii** (v. A. v. R.) C. Chr. — Pl. XI fig. 1.

*Drymoglossum Brooksii* v. A. v. R. Bull. Jard. bot. Buitenzorg II. no. XXVIII: 318. 1918.

*Grammatopteris Brooksii* v. A. v. R. ibid. III. 4: 318 pl. 15 fig. 1a—b. 1922.

*Grammatopteridium Brooksii* v. A. v. R. Nova Guinea 14: 24. 1924.

Type from Sumatra: Lebong Simpang, Benkoelen, I. C. J. Brooks no. 361 S. (*Bog*!), the only specimen seen.

Described from an immature specimen that agrees fairly well with the Papuan type, differing by the sinuate-repand, ovate-acuminate leaves and the proportionally longer stipes; stipe and lamina of the sterile leaf about equal in length, 10 cm., the very slender stipe of the fertile leaf 25 cm. long, the fertile portion less than 1 mm. wide.

var. **Beguinii** (v. A. v. R.) C. Chr. — Pl. IV fig. 13.

*Grammatopteris Brooksii* var. *Beguinii* v. A. v. R. Bull. Jard. bot. Buit. III. 7: 318 pl. 15 fig. 2a—c. 1918.

Differs from the type by lighter and quite entire rhizome-scales and the larger, acuminate sterile leaves, the largest of which measure: stipe 10—11 cm., the blade 25—30 by 7—8 cm.; fertile leaf up to 50 cm. long. — In size and shape recalling *Polypodium platyphyllum*.

Moluccas: Ternate (BEGUIN 1095, *Bog*);

CESATI's type of the present species was by BAKER believed to be an anomalous form of *Polypodium triquetrum* Bl. (Malesia 3: 46), and later on he identified it with a species from Sumatra described by himself in 1880 as *Polypodium costulatum*, a treatment followed in my Index. It is, however, quite false, *Pol. costulatum* Bak. being a non-drymoglossoid species allied to *Pycnoloma* § *Pleuripteris* (see my remarks pag. 79).

2. **Grammatopteridium ferreum** (Brause) C. Chr. comb. nov.

*Polypodium ferreum* Brause, Engler's Bot. Jahrb. 56: 197. 1920.

Type from New Guinea: Etappenberg, LEDERMANN no. 8881, *B*! also Felsspitze (LEDERMANN 12969 *B*!).

Rhizome scandent, 4—5 mm. thick, cylindrical, glaucous, toward the apex clothed with pale greyish, imbricated, broad, ovate-acute, entire, thin scales. Leaves numerous, spreading to all sides from the rhizome (not biserial as in other Polypodiæ), the sterile ones rigidly coriaceous, lanceolate, 10—15 cm. long incl. the short (0.5—1.5 long) stipe, 0.7—1.3 cm. wide, narrowed very gradually each way, finely acuminate, glabrous, pale whitish-green beneath; main veins distinct but not prominent, the margins

with distinct notches. Fertile leaves borne near the top of the rhizome, similar to those of *G. costulata*: stipe 2.5—3.5 cm. long, the linear blade up to 12 cm. long, 2 mm. wide; receptacles mostly continuous from base to apex, superficial in the mature leaf.

A very distinct species, agreeing in most characters with *G. costulatum*, differing by the larger rhizome-scales, the much narrower sterile leaves and especially by its peculiar strong, cylindrical rhizome, which bears leaves in several rows, some close together, some rather distant; by this character the plant recalls some species of *Oleandra*.

3. *Grammatopteridium pseudodryglossum* v. A. v. R. Nova Guinea 14: 24. 1924 (descr.).

*Grammatopteris pseudodryglossum* v. A. v. R. Bull. Jard. bot. Buit. III. 4: 318. 1922.

Type from Dutch New Guinea: Mamberano River, I. H. J. LAM no. 826.

This I have not seen; it differs from *G. Brooksii* by its very obtuse sterile leaves with glandulose stipes and underside.

The Relationship of *Grammatopteridium* is quite clear. In all important characters, the soral ones excepted, the known species are quite like some Malayan species of *Polypodium*. Thus the sterile leaves of typical *G. costulatum* may scarcely be distinguished from *Pol. triquetrum* Bl. and from some forms of *P. rupestre* Bl. *G. costulatum* var. *Beguinii* comes very near *Pol. platyphyllum* Sw., though scarcely closely related to it, and the sterile leaves of the smaller Papuan specimen (LEDERMANN 11215) figured on pl. VIII are perfectly like those of *Pol. de Kockii* v. A. v. R. (cf. Nova Guinea 14 pl. 1 fig. B), syn. *P. prolixum* Rosenstock! These and other species of *Polypodium* (f. inst. *P. Bakeri* Luer<sup>1</sup>) and *P.*

<sup>1</sup>) My remarks above were printed when I received the type-sheet of *Pol. Bakeri* Luer<sup>ss</sup>. (*P. torulosum* Bak.) from Herb. Beccari, Firenze. v. A. v. R. has published a drawing of a cotype-specimen (Bull. Dépt. Agric. Ind. néerl. no. XXVIII pl. I. 1909) which does not agree very well with the majority of specimens in Herb. Beccari, the sterile leaves being too acuminate; the real type perfectly matches *Pleopeltis pseudo-lateralis* v. A. v. R. Bull. Jard. Buit. II no. XXVIII: 36, pl. VI, 1918, which must be reduced to a synonym. Very near to *P. Bakeri* come some specimens from Papua (LEDERMANN 11488, 12625, 12860a, B), referred by BRAUSE (Engl. Jahrb. 56: 197) to *P. iboense*. They may belong to *Pleopeltis Gibbsiae* v. A. v. R. l. c. 1918: 37, and they are certainly very closely related to *Gram. costulatum*, perhaps a form of it with polypodioid, oblong sori; the sterile leaves can scarcely be distinguished from the narrow form of *Gr. costulatum*, but the scales are somewhat different, narrower, brown, the rhizome more slender and the fertile leaves up to 5 mm.

*Valetonianum* v. A. v. R.) belong to the genus *Pleuridium* as defined by J. SMITH (Hist. Fil. 94), more exactly to his second section of that genus. I have examined a good many specimens of these species and find them representing several forms, some of which have notched margins others not. It cannot now be proved if this difference indicates two separate phyletic lines, but in any case it seems sufficient here to state that *Grammatopteridium* is a drymoglossoid genus derived from the polypodioid group *Pleuridium*. Another question is whether the genus is really distinct from *Pycnoloma*. The settling of that question depends of the mutual relationship of *Phymatopsis* and *Pleuridium*. If the Asiatic species referred by J. SMITH to these two "genera" after a detailed analysis of a large material should appear to belong to a single natural group it would then be quite natural to unite also the two drymoglossoid genera.

### **Drymoglossum Presl.**

*Pteropsis* Desvaux, ex parte.

Rhizome wide-creeping, ageotropical, the scales peltate, mostly ciliate. Leaves entire, thick, succulent, when young rather densely clothed with stellate hairs, decidedly dimorphous. Veins immersed, anastomosing and forming oblique areoles with or without free veinlets; principal lateral veins indistinct. Sporangia borne on a linear receptacle, intermixed with or surrounded by stellate hairs. Spores coarsely verrucose or echinulate.

Type-species: *Pteris piloselloides* L.

#### Key to the Species.

- |  |                             |
|--|-----------------------------|
| 1. Rhizome-scales fimbriate or ciliate .....   | 2                           |
| Rhizome-scales entire .....  | 6                           |
| 2. Receptacle medial, the sporangia covering the whole under surface of the fertile leaves .....   | 3                           |
| Receptacle supramedial or submarginal, sporangia forming linear marginal coenosori, leaving the central portion of the surface uncovered .....   | 4                           |
| 3. Sporangia not arranged in two distinct rows, mixed with stellate hairs .....  | 1 <i>D. heterophyllum</i> . |
| Sporangia (in young fertile leaves) arranged in two distinct rows on each side of the midrib, the rows separated by a mass of slender branched hairs, bordered outside by petiolate stellate hairs. 2 <i>D. fallax</i> |                             |

broad, more or less repand, the sori not immersed, often 1 cm. long and often confluent forming distinct continuous coenosori. Such forms prove, I think, that *Grammatopteridium*, if maintained as a genus, should be extended to include all species of *Pleuridium* with linear fertile leaves.

4. Asiatic species; rhizome-scales appressed, rather shortly fimbriate 5  
Madagascar; rhizome-scales not appressed, densely long-fimbriate 4 *D. niphoboloides*
5. Rhizome-scales deciduous; stellate hairs with long branches; fertile  
leaves not much longer than the sterile ones; coenosori supra-  
medial, often confluent..... 1 *D. heterophyllum* var. *Beddomei*.  
Rhizome-scales persistent; stellate hairs with short branches; fertile  
leaves much longer than the sterile ones; coenosori marginal, not  
confluent ..... 3 *D. piloselloides*
6. Fertile leaves shorter than the sterile ones ..... 5 *D. crassifolium*  
Fertile leaves much longer than the sterile ones .... 6 *D. novo-guineae*

1. ***Drymoglossum heterophyllum* (L.) Trimen**, Journ. Linn. Soc. **24**: 152.  
1887; C. Chr. Ind. 246. 1905; excl. most synonyms. — Plate XII  
fig. 1, 6; XIII fig. 3.

*Acrostichum heterophyllum* L. sp. 1067. 1753 (Fl. zeyl. no. 378, Amoen.  
Acad. 1: 268 pl. 12 fig. 2).

*Pteris piloselloides* Houttuyn, Nat. Pfl. Syst. ed. germ. **13**<sup>1</sup>: 101 pl. 96  
fig. 1. 1786.

*Pteris elliptica* Willd. sp. **5**: 356. 1810.

*Pteris ceilanica* Wikstr. Sv. Vet. Akad. Handl. **1825**: 443. 1826.

*Pteropsis elliptica* Desv. Prodr. 218. 1827.

*Drymoglossum ellipticum* Moore, Ind. XXXI. 1857.

Type from Ceylon, collected by PAUL HERMANN and first described  
by LINNÆUS in *Flora Zeylanica* 1749.

*Acrostichum heterophyllum* L. has been reduced to a synonym of *Pteris piloselloides* L. (1763) by almost all writers and I followed them in my Index, of course preferring the older specific name *heterophyllum*, but overlooking that TRIMEN in 1887 had published the right combination. *Dr. heterophyllum* of my Index is, however, as to most synonyms and the distribution given rather *Dr. piloselloides* of this paper than the genuine *Dr. heterophyllum* as here understood. *Pteris elliptica* Willd. (*Pt. ceilanica* Wikstr.) is based only on HOUTTUYN's figure of a Ceylonese plant called *Pt. piloselloides*. WILLDENOW misunderstood the figure that shows sterile leaves only, believing that the leaves were uniform. The type-specimen of *Acrostichum heterophyllum* was referred by NAKAI (l. c. 388) to *Dr. rotundifolium* Pr., which I refer to *Dr. piloselloides*.

Having now examined a fair number of specimens from Ceylon, which are very uniform and agree with the descriptions of LINNÆUS as well as with HOUTTUYN's figure I have no doubt that they belong to the genuine *Acr. heterophyllum* L. These specimens differ in some important characters from all forms of *D. piloselloides* and they can not naturally be referred to that species, so I do not hesitate, to reestablish the old species of LINNÆUS. The characters by which it chiefly differs from *D. piloselloides* are the following.

Rhizome-scales reddish-brown, less densely lacerato-fimbriate and when young with a subentire acuminate tip, deciduous, the older rhizome

being almost quite naked. Sterile leaves circular, 1 to 1.5 cm. long and wide, or obovate or elliptical, up to 3 cm. long; fertile ones narrowly spatulate, 5 to 8 cm. long, 3 to 4 mm. broad, attenuated downward nearly to the phyllopodium, the tip broadly rounded. Coenosori confined to the upper two-thirds or more of the blade, the sporangia borne on vaulted receptacles medial between the midrib and the revolute margins, covering the whole under surface and mixed with petiolate stellate hairs. Spores coarsely verrucose, the prominences obtuse or acute, not close. Both sides of blade stellato-pilose, the hairs with rather long branches, deciduous and mostly abraded in the specimens.

Ceylon, several specimens seen (f. inst. THWAITES 3076, HÜGEL 3752, RECHINGER 2389, Kew Distr. 1107, *Wi*, WALL, *RB*, and others in *Kew*).

South India: Travancore, Cochin (GAMBLE 14806, BOURNE 5270, *Kew*).

var. *Beddomei* (Clarke) C. Chr. comb. nov. — Plate XII fig. 2 a—c.

*Drymoglossum Beddomei* Clarke, Tr. Linn. Soc. II. Bot. 1: 576. 1880 (nomen nudum).

*Drymoglossum piloselloides* var. *Beddomei* Bedd. Handb. 413. 1883.

*Niphobolus nummularifolius* Bedd. Ferns S. Ind. pl. 186.

Differs from the type by the very long branches of the stellate hairs and by the shorter and broader fertile fronds, 2.5 to 3.5 cm. long, 5 to 7 mm. wide, sometimes approaching the sterile ones in shape; sporangia mixed with numerous long-branched stellate brown hairs which entirely cover the young sori.

South India: Nilgiri (BEDDOME no. 15, *Kew*, type); Cochin (K. RUNGACHARI, *Kew*).

A critical form, perhaps a distinct species. The two specimens are not wholly alike, and the type from Nilgiri comes very near to *Cyclophorus nummularifolius* in pubescence, but the sori are drymoglossoid.

2. *Drymoglossum fallax* v. A. v. R. Philipp. Journ. Sci. 11 C: 111 pl. 6. 1918. — Plate XII fig. 7, XIII fig. 5.

*Drymoglossum Schlechteri* Hieron. et Brause, Engler's Bot. Jahrb. 56: 177. 1920.

*Drymoglossum subcordatum* Fée, 3. mém. 29, Gen. 94 pl. 9 A fig. 1 ex parte.

Type from Amboina, ROBINSON no. 1952 (Hort. Bogor.!).

Very like *D. heterophyllum* in size and shape of leaves. Rhizome-scales short-ciliate with long hair-pointed, brown and with age whitish tips. Sterile leaves orbicular, ovate or obovate, the fertile mostly 4—5 cm. long by 2—3 mm. wide, linear, very obtuse, on stalks 1 cm. long. Sporangia of a deep red-brown colour, densely packed and covering the whole surface. In young leaves they are arranged in two very distinct and regular rows on either side of the midrib, the capsules being placed side by side as cakes in a tinbox, the rows spaced out from each other by a woolly tomentum.

On a close examination of cross-sections it is seen that the sporangia are borne along the flanks of a broad receptacle, which runs in the bottom of a deep groove that extends almost from the costa to the edge. The centre of this groove is filled with a dense mass of slender branched woolly hairs, while the leaf-tissue outside the receptacle bears a mass of stalked stellate hairs; both kinds of hairs are fairly well illustrated by v. A. v. R. Spores tuberculate.

Moluccas: Amboina (ROBINSON 1952 *Bog!* and LABILLARDIÈRE, not seen;

J. B. STEERE, *Kew!*), Buru (Kew Distr. 1107 pp. *RB*).

New Guinea: Papua (Kaiser Wilhelmsland) (SCHLECHTER 16340, 18950, LEDERMANN 7639, 8104, all *B*).

New Britannia (New-Mecklenburg): Namatanai (PECKEL 778, *B*).

As to the synonymy of this interesting species there remains no doubt that *D. Schlechteri* Hieron. et Brause is identical with *D. fallax* v. A. v. R.

*Dr. subcordatum* Fée was based principally, I think, upon specimens from "*littorali Chinensi*", leg. GAUDICHAUD. Several specimens from Hong-kong leg. GAUDICHAUD are in Herb. Berol. and no doubt originate from the type-collection of *Dr. subcordatum*. All belong to *Lemmaphyllum microphyllum*. FÉE, however, quotes another locality: "in Amboina (Labillardière)". The specimen from that island is certainly not *L. microphyllum* but, I believe, *Dr. fallax*. The principal figure in Gen. Fil. pl. 9 A fig. 1 showing a portion of the rhizome with several leaves in natural size represents *D. fallax* rather than *Lemmaphyllum*; the fertile leaves are linear as in the former not spatulate as in the latter species; the illustration further shows a stellate hair which is also to represent the hairs of *D. subcordatum*, but stellate hairs do not occur in *Lemmaphyllum*. I conclude, therefore, that FÉE's illustration of *D. subcordatum* represents *D. fallax*, while his description agrees best with *Lemmaphyllum microphyllum*. In any case NAKAI was wrong in referring the species of FÉE to *D. rotundifolium*.

3. *Drymoglossum piloselloides* (L.) Presl, Tent. Pteridogr. 227 pl. 10 fig. 5, 6. 1836. — Plate XII fig. 4—5, XIII fig. d.

*Pteris piloselloides* L. sp. ed. II. 1530. 1763.

*Drymoglossum heterophyllum* pro parte C. Chr. Ind. 246; NAKAI, Bot. Mag. Tokyo 40: 390. 1926 (excl. some syn.); GOEBEL, Ann. Jard. Buitenzorg 36: 140—144, fig. 75—78. 1926.

*Drymoglossum rotundifolium* Pr. Epim. Bot. 157. 1849; NAKAI, l. c. 388 c. fig.

Type from "India orientali".

Scales of the slender rhizome elliptic, fixed at the centre, densely lacinate-fimbriate by thin at least hair-like cilia, when young reddish-brown with a black centre, terminating in a more sparsely fimbriate acuminate cusp that is soon broken off; scales very consistent and even old rhizomes are covered with bleaked, grayish scales with short whitish cilia and without cusp. Sterile leaves very variable in shape, sometimes nearly orbicular, 1 cm. wide each way, sometimes oblong 5 to 6 cm. long by 1 to

1.5 cm. wide. Fertile leaves broadly linear, 8 to 15 cm. long, 6 to 8 mm. wide, obtuse, very gradually attenuate towards the short stipe. Coenosori when young more or less immersed in a submarginal groove with raised edges, at maturity superficial with the thick black receptacle at the same plane as the surface of the blade, still often with a sharp rim on the inner side. The mature sporangia form a thick marginal band, 1 to 1.5 mm. broad, continuing round the tip of the blade, leaving a broader or narrower central portion of the blade uncovered, mixed with petiolate stellate hairs. Spores echinulate, i. e. the warts very sharp. Surfaces of young leaves with scattered minute stellate hairs with very short branches. — For further details see GOEBEL l. c.

This common and widely distributed species is best known now by the name of *D. heterophyllum*, but as shown above it is not *Acrostichum heterophyllum* L. NAKAI recognized two species characterized by the shape of the sterile leaves only, but I cannot agree with him in regarding that character as a good one. Both kinds of leaves, the round and the obovate-oblong, may be found in specimens from the whole area of the species and even on the same rhizome, and I have failed to characterize positively geographical races. Most distinct is a large form with long oblanceolate sterile fronds, which is often collected in the Malay Peninsula, Borneo and the Philippines; its fertile leaves are not rarely furcate or crested at the apex with short obtuse lobes.

*Dr. rotundifolium* Pr. is according to NAKAI's sketch of the type-specimen a form of *Dr. piloselloides* with small round sterile leaves. It is said to be collected "in Pendschab" (N.W. India), probably due to an error, as the species has never since been collected in that part of India. As to the synonyms quoted by NAKAI under his two species, here united, some of them belong to other species; he is quite wrong in believing that "*Dr. rigidum* Hook. is a well-grown *Dr. piloselloides*" (l. c. p. 386); it is not even congeneric with that species. *Dr. abbreviatum* Fée, referred to *Dr. rotundifolium*, is a species of *Lemmaphyllum*, and *Dr. subcordatum* Fée is partly *Lemmaphyllum microphyllum*, partly *Dr. fallax*.

The area of *Dr. piloselloides* is tropical Asia with the centre in the Malayan region. It is common in low altitudes from Sumatra and the Malay Peninsula to the Philippines and New Guinea, growing ageotropically on branches and trunks of trees. I have examined approximately 200 specimens from this region and find it unnecessary to enumerate them here. Besides these I have seen specimens from:—

India: North-east Indian lowlands (Bengal plains, Assam and Burma) I have seen no specimens from South-India, where according to BEDDOME (Handb. 413) it is common in the Malabar Plains; all specimens seen from this region belong to *D. heterophyllum* var. *Beddomei* but for one in Herb. Vahl, leg. KÖNIG (H); no exact locality is indicated and it may be collected in Penang or Singapore.

Hainan, near Hoihow (HANCOCK 15, *Kew*, 35 *Le*), Sha Po Shan (TS'ANG WAI TAK 16074 p.p., 17146, *Cal*).

French Indochina: Annam: Phu Phong (EBERHARDT 215, *RB*), Tonkin: Dong Dang (BALANSA 159, *Kew*, *Le*).

Siam: Bangkok (KERR 4307, *Kew*), Sangka (KERR 8022, 8277, *Kew*), Koh Chang Island (JOHS. SCHMIDT 182, 179, 416, 660 a, *H*).

A specimen in Herb. Christ (*RB*) from Martinique: St. Pierre named *Dr. martinicense* Christ is typical *Dr. piloselloides*; the type of *Dr. martinicense* (*B*) is *Cyclophorus adnascens*. Both species seem to be naturalized in Martinique.

4. *Drymoglossum niphoboloides* (Luerss.) Baker in Hook. Ic. plant. pl. 1686. 1887. — Plate XII fig. 8, XIII fig. 1—2.

*Taenitis niphoboloides* Luerssen, Abhandl. Nat. Ver. Bremen 7: 49 pl. 1 fig. 3—5. 1883.

Type from Madagascar: Alabé, leg. RUTENBERG (Herb. Luerssen 9673, *RB*!).

This species resembles *D. piloselloides* in size, pubescence and varied shape of the sterile leaves, differing chiefly in scale-characters and by venation and spores. The scales of the slender, wide-creeping epiphytcal rhizome are ovate-lanceolate, not appressed and fixed rather near the base, rather thin, reddish-brown, densely fimbriate by numerous long cilia that give the rhizome a woolly aspect. Sterile leaves oval, elliptical, oblong, lanceolate obtuse all kinds found on the same rhizome, the largest 8 to 10 cm. long 1 to 1.2 cm. wide, often not essentially different from the fertile ones. These are linear-lanceolate, 10 to 20 cm. long by 1 cm. wide, gradually narrowed towards the short stipe. The venation is shown in pl. XIII fig. 1, 2; almost all areoles contain a free, simple or forked veinlet that always runs toward the slender midrib. Both surfaces of young leaves nearly covered with stellate hairs which soon drop. Coenosori submarginal, often interrupted, the sporangia borne on a vaulted receptacle just within the edge, mixed with petiolate stellate hairs; the mature sporangia form a thick marginal band generally equally visible from both sides. Spores bean-shaped, beset with unequal obtuse warts.

Madagascar (RUTENBERG, PERRIER DE LA BÂTHIE 7993, 11551, 15095 *RB*, HUMBLLOT 310, *RB*, *Kew*, *Wi*; SCOTT ELLIOTT 2739, *B*, *Kew*, *W*. KAUDERN, *CC*, BARON 5420, *Kew*).

#### Species of doubtful position.

The two following species from New Guinea described as *Drymoglossum* agree in some characters: dimorphous leaves, linear receptacles and stellate pubescence with the species described above, but as to other characters, chiefly the different scales, texture, stronger midrib and others they certainly differ so much that they cannot naturally be placed in the same group but must be regarded as members of another group deriving equally from *Cyclophorus*, and perhaps they should be referred to that genus. Unfortunately the type-specimens seen are so scanty that I am not able to say with certainty in which genus they should be placed.

5. *Drymoglossum crassifolium* Brause, Engler's Bot. Jahrb. 49: 35. 1912. — Plate XII fig. 3.

Type from New Guinea: Kaiser Wilhelmsland, Maboco (SCHLECHTER 19874, *B*/).

Rhizome densely covered with imbricated, peltate scales, the basal part of which is ovate, firm, nearly black with whitish entire edges, narrowed into a thinner, lanceolate-subulate brown tip turning white with age and finally broken off. Sterile leaves very thick, ovate-oblong, 4 cm. long, 2 cm. wide, sparsely stellato-pilose; veins invisible. Fertile leaf linear, obtuse, 2 cm. long by 2 to 3 mm. wide, the stipe 2 to 3 mm. long with many stellate hairs; the sporangia cover the whole under surface, mixed with stellate hairs.

Apparently near *D. heterophyllum*, differing by the short fertile leaves, thick texture and especially by the scales; judging from these the species should perhaps be referred to *Cyclophorus*, but unfortunately the only fertile leaf of the type-specimen did not permit me to examine the receptacles without damaging the specimen.

6. *Drymoglossum novo-guineae* Christ in Schum. et Lauterb. Fl. deutsch. Schutzgeb. in der Südsee 137. 1905. — Plate XI fig. 2.

*Cyclophorus novo-guineense* Nakai, Bot. Mag. Tokyo 40: 386. 1926.

*Cyclophorus Bamlerii* Rosenst. Fedde, Repert. 10: 339. 1912.

*Cyclophorus Ledermanni* Brause, Engler's Bot. Jahrb. 56: 206. 1920.

Type from New Guinea: Kaiser Wilhelmsland, Sattelberg (LAUTERBACH 570, n. v.; ERIK NYMAN 404 b, *RB*, *CC*, BAMLER ed. Rosenst. Fil. novoguini. exs. 107, *B* = *C. Bamlerii*); Sepik Geb. (LEDERMANN 8840, *B* = *C. Ledermanni*).

Resembling the former species in scale characters, texture and shape of the sterile lamina, but much larger. Sterile oblong, acute, rounded at base, 6 to 8 cm. long, 3 cm. wide, the stipe 2 to 3 cm. long, the underside with rather numerous very minute stellate hairs consisting of a rather large disc and short broad rays; principal lateral veins faintly visible beneath. Fertile leaf 17 cm. long including the stipe (this 3.5 cm. long) about 4 mm. broad, shortly acute, long cuneate at base, the margins narrowly revolute; the whole underside covered with sporangia, which are borne on a linear, superficial receptacle, 0.5 mm. broad and close to the raised midrib, mixed with stellate hairs.

*C. Bamlerii* Ros. is the typical form; *C. Ledermanni* Brause differs a little by the long hair-pointed rhizome-scales but I cannot consider it specifically different.

### The Relationship and Systematic Position of *Drymoglossum*.

Among the "drymoglossoid" genera *Drymoglossum*, as here delimited, is especially characterized by the stellate hairs and paraphyses, thus distinguished from all others by the same character by which the polypodioid genus *Cyclophorus* differs from

*Polypodium*. While the other genera find their nearest relatives within the subgenus *Pleopeltis*, no known species of *Polypodium* is nearly allied to *Drymoglossum*, which cannot, therefore, be directly derived from any group of that large genus and consequently it is not closely related to *Lemmaphyllum* and *Pycnoloma*, although these three genera have been united into one by nearly all authors. To me it is beyond doubt that *Drymoglossum* is very intimately allied to *Cyclophorus*, from which it differs chiefly by its sorus-characters, thus standing exactly in the same relation to that genus as *Lemmaphyllum* to *Polypodium* § *Lepisorus*. The two genera are in reality so near each other that it would be quite natural to unite them, inasmuch as the only character by which they should be distinguished, round sori in one, linear coenosori in the other genus, here too is an unstable one. It is true that the coenosori of the species described above are rarely much interrupted — most frequently in *D. niphoboloides* — but in certain species of *Cyclophorus* we find all transitions between punctiform and linear receptacles, thus in *C. confluens* and *C. taeniodes* C. Chr.<sup>1)</sup>. Especially the latter species from China is quite drymoglossoid in sorus-characters, still both of these species differ from *Drymoglossum* by their uniform leaves.

The other important character of *Drymoglossum*, the dimorphous leaves, scarcely alone justify its segregation as a genus. Within *Cyclophorus* we find several species with decidedly dimorphous leaves, f. inst. *C. nummularifolius* (Sw.) C. Chr. and *C. adnascens* (Sw.) Desv., two common Malayan species. The former is so like *D. Beddomei* in all characters, the sori excepted, that it is scarcely distinguishable in a sterile state, and *C. adnascens* is equally similar to *D. piloselloides* and often confounded with it in the herbaria. Both of these species have round sori and must accordingly be regarded as species of *Cyclophorus* although in other characters, f. inst. their succulent leaves and wide-creeping rhizome they closely agree with *Drymoglossum*. Thus it is seen that neither of the two most important characters of *Drymoglossum*, dimorphism and coenosori, is sufficient for its segregation, but it seems convenient to maintain the genus when it is confined to include those species only which show the two characters com-

<sup>1)</sup> See GIESENHAGEN: Die Farngattung *Niphobolus*, fig. 11 C—F, p. 62 (*Niph. angustissimus* is a synonym of *Cyclophorus taeniodes*).

bined; otherwise it seems impossible to draw a definite line between the two genera. This treatment is convenient but it is certainly a purely artificial classification. Following it the two last described species: *D. crassifolium* and *D. novoguineæ* belong to *Drymoglossum*, but other characters such as scales and texture show that they come very near to *Cyclophorus*.

All things considered I conclude that *Drymoglossum* is an artificial genus; its single species are independent offshoots from *Cyclophorus* or perhaps from the nearest ancestors of that genus, the species of which belong to several evolutionary series, and some of these have developed drymoglossoid species. The case is exactly parallel to that of *Lemmaphyllum*—*Lepisorus*. The species of *Drymoglossum* have their nearest allies in species of *Cyclophorus*, only *D. niphoboloides* seems to be an isolated form; I do not know any species of *Cyclophorus* from Madagascar with which it may properly be compared.

### Conclusion.

In this paper I have given a monographical review of about all known species of thirteen different genera, which fall into two groups:

1. The *Cochlidiinae*, comprising three genera: *Cochlidium*, *Scleroglossum* and *Nematopteris*, to which belong a small number of species, all previously referred by most authors to *Monogramma* or *Vittaria*. It is shown, however, that these species cannot naturally be placed in the tribe *Vittarieæ* but that their nearest relatives are to be found among the simple-fronded species of *Polypodium* § *Eupolypodium* (*Xiphopteris*, *Grammitis*) and that they must be regarded as derivatives of an ancient stock of polypodioid ancestors. The group may rather naturally be placed as a well defined special tribe under the subfamily of *Polypodieæ*.

2. The other group, comprising the remaining ten genera, corresponds chiefly to the tribe *Taenitidinae* of Diels with the exclusion of the two genera *Taenitis* and *Platytaenia*. That tribal name cannot properly be used for a group not including *Taenitis*, and I have, therefore, in my introductory remarks provisionally called it the *Drymoglossinae*. It is proved that this group is not

a natural one and that the nine genera cannot naturally be placed in a single group, and that tribal name must also be dropped.

The ferns in question are very like in soral characters, having longitudinal exindusiate coenosori, but this character does not indicate a close relationship. The fusion of single sori into coenosori is an evolutionary state arrived at independently by recent ferns which, phyletically, are derivatives of different polypodioid ancestors. This state, the *drymoglossoid*, is in some cases (*Hymenolepis*—*Leptochilus*) an intermediate one between the polypodioid and acrostichoid state, in others it seems to be the last arrived at.

It is presumed that the drymoglossoid genera are young, being proportionally recent offshoots from the huge mass of polypodioid ferns now usually placed under one genus, *Polypodium*. In the concluding remarks bearing upon the phylogeny of each genus I have shown to which smaller group of *Polypodium* it is most closely related, and it was there discussed whether the genera may phyletically be considered direct, recent derivatives from the related polypodioid group or be specialized branches from the large old trunk of polypodioid ferns, from which the recent groups of *Polypodium* have also developed. These problems cannot be solved definitely by a study of facts but must naturally be a subject of speculation, and considerations of this kind are in my opinion without scientific or practical interest. One must be satisfied to state with the degree of certainty that a reasonable interpretation of the facts permits, where the genera dealt with should be placed in a really natural classification of recent ferns. As to this point I feel sure that my conclusions are right. In the necessary linear arrangement of genera it is difficult to place these genera in their natural position, which would be between certain species or groups of *Polypodium*. The best way out seems to me to place them together in an appendix to *Polypodium* with the heading: Drymoglossoid genera derived from the Polypodieae, thus indicating that they do not form a natural, phyletic group. Their real relationship is shown in the following table, in which the results of my studies are summarized.

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Table showing the supposed Affinity of the thirteen Genera to the different Groups of Polypodiæ.

Polypodium sens. lat.	§ Grammitis .....	{ —Xiphopteris.....	Cochlidium
		{ —Oreogrammitis?....	Scleroglossum
			Nematopteris
	§ Eupolypodium		
	—		
	§ Goniophlebium .....	{ § Campyloneurum	
		{ § Phlebodium	
	§ Marginaria .....		Marginariopsis
	§ Pleopeltis .....		Eschatogramme
	—		
	§ Lepisorus .....	{ ? Paltonium	
		{ Lemmaphyllum	
		{ Drymotaenium	
	—	{ Hymenolepis	
	— ? .....	{ Myuropteris	
	§ Crypsinus or § Phymatopsis.....		Pycnoloma
	—		
	§ Pleuridium.....		Grammatopteridium
	—		
	Other groups of Asiatic Species		
	—		
	§ Phymatodes		
	Cyclophorus .....		Drymoglossum

## II.

### On a small Collection of Ferns from the State of Amazonas, Brazil, made by Mr. A. ROMAN 1924.

The collection here dealt with was sent to me for identification by Dr. SELIM BIRGER, Stockholm. Most specimens were gathered near Taracuí, Rio Waupes (Uaupés), in the northwestern corner of Amazonas, not far from the Venezuelan border. The place is situated between São Gabriel and Panoré, two localities made famous by R. SPRUCE's collections made there in 1852. Ferns from this region are mostly very poorly represented in herbaria, and the following list may, therefore, be of some value, also because several of the beautiful specimens collected by Mr. ROMAN agree exactly with some Sprucean ones which have been referred to wide-spread species, although they really belong to very well defined species, apparently of limited distribution. The most characteristic feature of the fern-flora of the vast Hylæa-region is the high percentage of *Hymenophyllaceæ*, chiefly belonging to the subgenera of *Trichomanes*, *Neurophyllum*, *Lacostea* and *Ptilophyllum*.

*Hymenophyllum angustum* v. d. B. Ned. Kr. Arch. 5<sup>3</sup>: 183. 1863. — Taracuí, on mossy tree-trunks in sandy forest, no. 16.

This species was referred in my Index to *H. hirsutum* Sw. The specimens agree closely with v. d. BOSCH's description of the type-specimen from São Gabriel l. SPRUCE (cotype in B!) and differ considerably from the typical West-Indian *H. hirsutum* by the linear leaves that are 5—10 cm. long by 1 cm. wide, of firmer texture, densely reddish pilose by branched hairs.

*H. ciliatum* Sw. — Taracuí, creeping round small, mossy tree-trunks, no. 38 part.

*H. polyanthos* Sw. — Taracuí, common on mossy tree-trunks, no. 4, 15, 22, 38 part.

A characteristic form of this polymorphic species, perhaps a distinct species, marked by the short, broadly-deltoid leaves ( $7-8 \times 4$  cm.) with very short stipes.

*Trichomanes (Neurophyllum) Hostmannianum* (Kl.) Kze. — Taracúa, on swampy ground at riverside in forest, no. 31.

*Tr. (Neurophyllum) pinnatum* Hedw. — Taracúa, on the ground in forest, no. 32.

*Tr. (Lacostea) tanaicum* Hook. — Near Rio Waupés, climbing and scandent on small tree-trunks in the forest no. 30.

*Tr. (Lacostea) Ankersii* Hook. et Grev.

A species characteristic of the Hylaea, where its very long, slender, wiry rhizome is creeping on tree-trunks or twining round smaller branches, very firmly adherent to them, and the biserial leaves are so densely appressed to the substratum, that small parts of this (bits of bark etc.) are adherent to the underside of the leaves, when these are loosened. This is, of course, impossible, when the rhizome is twining on small branches, and it seems to me that the great variation of the leaves is at least partly due to these different growing-places. For the species as here understood is very variable and includes several forms described as species by v. d. BOSCH and STURM (Fl. bras.). The present material contains three different forms, which I have tried in vain to identify with certainty as to forms.

1. Near the type (HOOK. and GREV. Ic. pl. 201). Segments 2.5 cm. long, 7—8 mm. broad, entire, very obtuse; "spurious veins" many; sori 1—3. Leaves densely appressed to the trunk.

Rio Negro: Umarituba, no. 3a.

2. Like the former, but segments regularly and sometimes deeply dentate; when twining this form approaches *Tr. pedicellatum* Desv., which, however, is deeply bipinnatifid with very few "spurious veins" (cf. HOOK. and GREV. pl. 218, *Tr. radicans*).

Rio Negro: Umarituba, no. 1 and 3b; Taracúa, no. 37.

3. *Tr. guianense* Sturm. Smaller than the former, twining, the segments not close, tapering toward the rather acute point, decurrent at base, irregularly dentate; "spurious veins" rather many; sori 1—3, distinctly pedicellate often recurved.

Taracúa, no. 17.

*Tr. (Ptilophyllum) bicornis* Hook. — Taracúa, on the ground and on rotten fallen tree-trunks in the forest, no. 11 and 21.

*Tr. (Ptilophyllum) macilentum* v. d. B. — Taracúa; on rotten fallen tree-trunks on swampy soil in the forest, no. 10.

*Tr. (Ptilophyllum) Gardneri* v. d. B. Ned. Kr. Arch. 5<sup>2</sup>: 149.1861; et Syn. Hymenoph. ed. Goddijn; Meded. Rijks Herb. Leiden no. 38: 18 fig. 34. 1919. — Taracúa, on the ground in forest, no. 34.

Among the many species allied to *Tr. crispum* L. adopted by v. d. BOSCH *Tr. Gardneri* agrees best with the present specimens. They differ from

typical *Tr. crispum* by the two veins surrounding the involucre proceeding beyond it like two horns, and by the much shorter receptacles. The segments are irregularly subdentate, the 2—3 lower ones reduced and reflexed.

*Tr.* (Ptilophyllum) *Martiusii* Presl, Hym. 36; v. d. B. Syn. Hymenoph. ed. Goddijn l. c. 25 fig. 38.

Syn. *Tr. plumula* Presl, l. c., v. d. B. l. c. 26.

*Tr. pilosum* Martius, Ic. Cr. Bras. 104 pl. 68. 1834 (not RADDI).

Taracuá, on mossy tree-trunks, rather common, no. 23 and 34 ex parte.

The two species of PRESL here united were founded exclusively on MARTIUS's excellent illustrations, which show two somewhat different plants, a larger one with deflexed lower segments on the left hand (*Tr. plumula* Pr.) and a narrower form with the lamina very gradually narrowed below (*Tr. Martiusii* Pr.); both were collected in the Rio Negro region by MARTIUS. The specimens now examined mostly resemble the latter form deviating by the lower segments being deflexed as in *Tr. plumula*, and I conclude, therefore, that PRESL's two species are extreme forms of the same species. Judging from the illustration of *Tr. pilosum* Raddi (Fil. Bras. pl. 69 fig. 1) it is very different from *Tr. Martiusii*.

*Tr.* (Leptomanes) *cellulosum* Klotzsch, Linnaea 18: 531. 1844; HOOK. 2. Cent. pl. 63; STURM Fl. Bras. 1<sup>2</sup>: 269 pl. 18 fig. 13; CHRIST, Bull. l'Herb. Boiss. 1902: 326. — Taracuá, on rotten, mossy tree-trunks, no. 5.

The rhizome of this very distinct species is either erect, 3—4 cm. high, with tufted leaves, or prostrate with scattered leaves, densely brown-hairy, the stipe of younger fronds is distinctly winged nearly to the base, of older ones unwinged; the leaf-tissue consists of 5—6 rows of large, clear cells at either side of the midrib of the ultimate lobes, the fertile lobe below the urceolate involucre very narrowly margined or almost reduced to the midvein.

Some of the pretty complete specimens exactly fit STURM's elaborate description of *Tr. cellulosum*, while others with prostrate rhizome and partly unwinged stipe agree with his *Tr. filiforme* (l. c. 269 pl. 18 fig. 14), but it is beyond doubt that all belong to one species. It seems, therefore, that *Tr. filiforme* Sturm in Ind. Fil. was rightly referred to *Tr. cellulosum*, but a cotype-specimen in Herb. Copenhagen (SPRUCE no. 2278 from São Gabriel), however, differs more by its smaller size, very narrow lobes with only 2—3 rows of cells at either side of the midrib, and especially by the stipe being sparsely pilose by reddish, intestinform hairs; such hairs I have not found in *Tr. cellulosum*. It is possible that *Tr. filiforme* is a form of *Tr. cellulosum*, still I should prefer to let it stand as a species provisionally. It is much more probable that *Tr. subdeltoideum* C. Chr. Ind. 650 (*Tr. Sprucei* Bak. Syn. 87) from the same region (SPRUCE 2535!) is a slightly different form of *Tr. cellulosum*; its lobes are somewhat broader and the fertile lobes are scarcely narrowed, the involucre distinctly winged nearly to the top.

**Lindsaya pumila** Klotzsch, *Linnaea* 18: 545. 1844, t. sp. orig. (B). — Taracúá, on the ground in forest, no. 26.

A small simply-pinnate species, in general habit closely resembling the Asiatic *L. cultrata* and *L. concinna*. It has scarcely anything in common with *L. guianensis* Dry., to which the species of KLOTZSCH was referred in Ind. Fil., but it is very like *L. cubensis* Und. et Maxon, differing from it by its purplish quadrangular stipe and rachis. Lamina 8—12 cm. long, 1.5 cm. wide, the pinnae rather distant, patent or sometimes reflexed, acute, short-stalked, cuneate or subtruncate at the upper base, the lower edge convex and thickened, the upper faintly crenate when sterile; sori continuous along the upper edge, marginal. The sori of *L. cubensis* are distinctly intramarginal. *L. pumila* is known from Guiana and Amazonas (San Carlos, Rio Negro, SPRUCE 3064, B).

*L. dubia* Spr. — Taracúá, on the ground in forest, no. 13.

*L. crenata* Klotzsch, *Linnaea* 18: 546. 1844; HIERONYMUS, *Hedwigia* 62: 16. 1920.

Syn. *L. curvans* Fée, Cr. vasc. Brésil 1: 30. 1869 (vix Gen. Fil.).

Taracúá, on sandy soil in forest, no. 20.

The single specimen is identical with the type of KLOTZSCH from British Guiana (SCHOMBURGK no. 274 partim, Herb. Berlin!), which HIERONYMUS considered specifically different from the related species *L. portoricensis* Desv. and *L. quadrangularis* Raddi, and he was perhaps right, still it is difficult to distinguish it safely from some forms of the latter species and of *L. lancea*. GLAZIOU no. 1653 from Rio Janeiro (Herb. Copenhagen), apparently wrongly named *L. curvans* by FÉE, is to me essentially the same form, to which I also refer other specimens from Southern Brazil (f. inst. GLAZIOU 12355) and Bolivia (Herb. Corn. Osten 16140). The typical form is marked by its terete castaneous stipe 20 cm. long, the blade 15 cm. with only 3 pinnae below the terminal one; they are 3.5 cm. broad with closely set, subimbricated pinnules, these 5—6 mm. broad, rectangular with the outer edge rounded truncate and distinctly, often coarsely, crenate. The indusia are very narrow and very near the upper edge, still not quite reaching it.

### **Polypodium panorense** sp. nov.

Syn. *Goniophlebium pectinatum* Moore, Ind. Fil. 395 pro parte; FÉE, Cr. vasc. Brés. 1: 108 (not J. Sm.).

*Polypodium loriceum* var. *pectinatum* Baker, Fl. bras. 1<sup>2</sup>: 523.

Species *Goniophlebii* P. *Wagneri* Mett. habitu magnitudine valde similis, a qua differt: rhizomate glauco, areolis uniserialibus, venulis exterioribus simplicibus, brevibus, marginem non attingentibus; paginis utrisque pilis albidis, mollibus, crispis, sat longis maxime ad rachin venasque instructis, nec minute puberulis.

Amazonas: Rio Waupés, Panoré, SPRUCE 2324 (type, Herb. Berlin);

Taracúá, epiphyte, A. ROMAN no. 35 and 36.

Scales of the short-creeping, glaucous rhizome lanceolate and finely acuminate, fuscous-brown with paler and obscurely ciliate margins. Stipe 3—6 cm., the blade 25—40 cm. long, 4—6 cm. wide, the horizontal acute segments 5—6 mm. wide, the lowermost ones usually reflexed, sometimes not or slightly abbreviated, sometimes reduced to mere auricles.

This new species is a member of a small group of Tropical American species, which very much resemble *P. pectinatum* L. in size and general habit but are distinguished by goniophleboid venation. To this group belong, besides *P. dasypleuron* Kze. which is unknown to me, *Goniophlebium pectinatum* J. Sm. Bot. Voy. Herald 230. 1854, from Panamá, which seems to be quite identical with *Pol. Wagneri* Mett. Ann. sc. nat. V. 2: 255. 1864, and *P. costaricense* Christ, Bull. l'Herb. Boiss. 4: 660. 1896, Bull. Soc. bot. Belg. 35: 222. 1896. I have had on loan from Berlin the whole material upon which METTENIUS based his *P. Wagneri* and find it comprising at least three different forms, one of which is *P. panorense* described above (SPRUCE 2324, by METT. named *P. Wagneri*). Although the specimen first quoted by METTENIUS is SCHLIM 636, I find it natural to consider a specimen from Panamá leg. WAGNER as the type, because the species was dedicated to that collector; the description of METTENIUS evidently covers both specimens. The type is well-marked by the veins forming two complete (and sometimes a third incomplete) rows of areoles, and by both surfaces of the leaf being minutely puberulous without long hairs; the rhizome is not glaucous. This form was collected in Guatemala by FRIDRICHSTHAL and in Panamá by HAYES, WAGNER and DUCHASSAING.

A variety of this typical *P. Wagneri* is probably *P. costaricense* Christ, to which I refer some specimens from Costa Rica l. HOFFMANN and Colombia (SCHLIM 636). It differs from the type by lighter colour, more acute segments, and especially by uniserial areoles and almost or quite glabrous surfaces.

A third form was collected in Cuba by WRIGHT (no. 806); it has the minute pubescence of typical *P. Wagneri*, the uniserial areoles of *P. costaricense*, differing from both by the lamina being more gradually narrowed below; the goniophleboid venation is rather incomplete, several areoles not being closed.

None of these three forms has a glaucous rhizome and the characteristic pubescence of *P. panorense*, which I therefore venture to describe as a different species now, as Mr. ROMAN has gathered exactly the same form first found by SPRUCE. Besides the characters mentioned it differs from the other forms by others, f. inst. the blackish veins.

### **Polypodium Thurnii** Bak.

Syn. *Drynaria acuminata* Fée, Cr. vasc. Brés. 1: 122 pl. 37 fig. 3. 1869 (not BRACK. 1854).

Taracúá, creeping on mossy tree-trunks.

A most distinct form, which I, in the Index, very improperly, following BAKER, referred to *P. lycopodioides* L. The present beautiful specimen is absolutely identical with the type of *Dr. acuminata* from the same region

leg. SPRUCE!, excellently illustrated by FÉE, and agrees very well with some specimens of *P. Thurnii* from Guiana and North Brazil (SPRUCE 1210, B), some of which have subdimorphous leaves. Its nearest ally is *P. nematorhizon* Eat. from Trinidad, differing from it by the leaves being elliptical, not lanceolate, and by the sori being a little inframedial, not supramedial.

***Elaphoglossum nigrescens* (Hook.) Diels (an var.?).**

Taracua, on rotten mossy trunks, no. 19; São Gabriel, SPRUCE no. 2187; Brazil, without locality, GLAZIOU no. 12344 (both Herb. Copenhagen).

The three specimens quoted are absolutely identical and they represent a very distinct species, which, with some doubt, I identify with *E. nigrescens*, a badly known species, described by HOOKER (sp. 5: 214) from specimens L. SCHOMBURGH at Mt. Roraima, British Guiana. As to most important characters they agree excellently with the original description: the erect, apparently quite naked rhizome, the very short unwinged stipes of the sterile leaves, which are very long decurrent at the base, this being like a winged stipe, and the very long (25—30 cm.) slender, naked, ebeneous stipe of the fertile leaves, the small blade of which (10—15 cm. long, 7—8 mm. broad) overtops the sterile leaves, these about 20—25 long by 2 cm. wide, acute. They differ from the described type by the rather distant veins not being clavate at the apex, at best a little thickened, and by the underside being dotted with very minute, peltate, subentire, firmly appressed scales, and the margins of young leaves being furnished with a row of light-brown, substellately branched scales, which are mostly fallen or abraded in older leaves, still some may nearly always be found. Typical *E. nigrescens* was described as "quite glabrous", which our specimens without very close examination also seem to be.

SPRUCE no. 2187, which perfectly matches ROMAN'S specimen from the same region, is quoted under 5 different species by different writers, viz. *E. Lechlerianum* by Moore (Ind. Fil. 359; cf. FÉE, Cr. vasc. Br. 1: 5), *Acrostichum flaccidum* by Hooker (sp. 5: 204), *A. flaccidum* var. *pallidum* by Baker (Fl. bras. 12: 569), *A. viscosum* by Fée (Cr. vasc. Br. 1: 9) and *E. stenopteris* by Christ (Mon. Elaph. 60). SPRUCE not rarely distributed several forms or species under the same number, and this, of course, may be the case here, but it is certain that our specimen of that number cannot properly be referred to any of the five species. It manifestly differs from them all by the light-coloured stipe and midrib of the sterile leaf and the black or dark-castaneous very long and slender stipe and midrib of the fertile one. In several characters the sterile leaves agree with *E. flaccidum*, still they are considerably smaller, and the fertile leaf is quite different.

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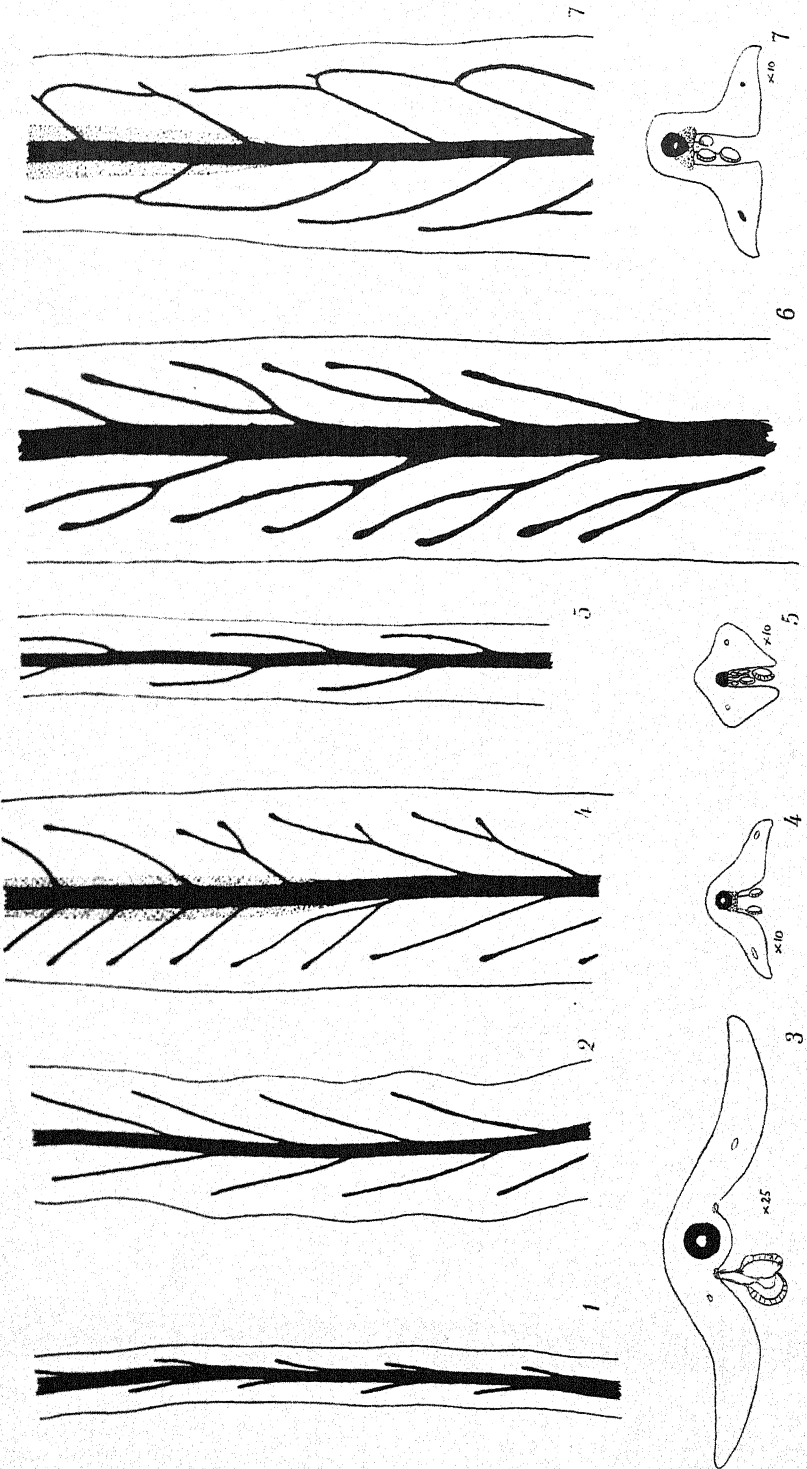
# PLATES

PLATE I.

*Cochlidium*. Venation and sections of

Fig. 1. *C. graminoides* (Sw.) Klf.

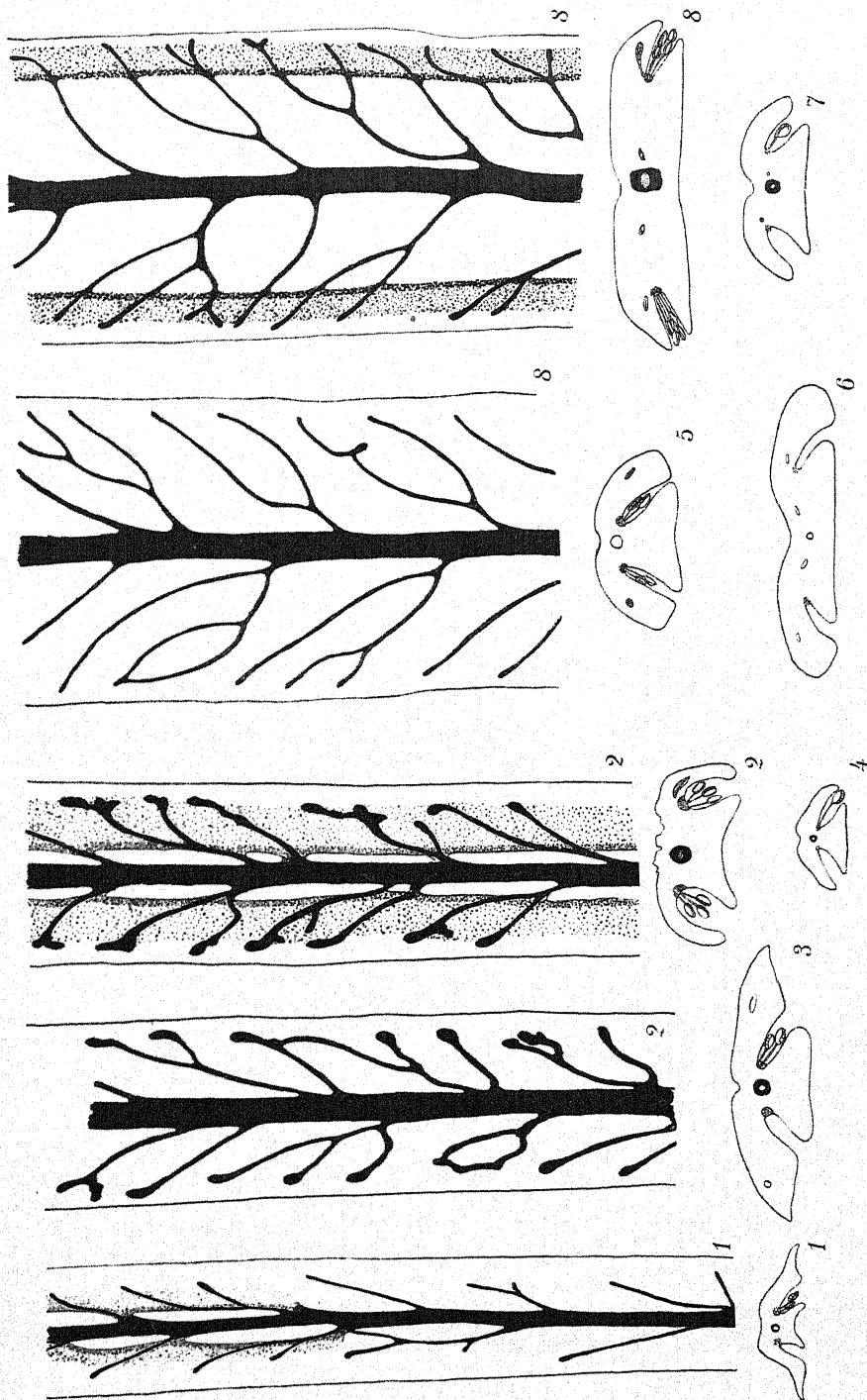
- 2. *C. minus* (Jenm.) C. Chr. (Cuba, SHAFER 3479).
- 3. *C. seminudum* (Willd.) Maxon.
- 4. *C. linearifolium* (Desv.) Maxon.
- 5. *C. rostratum* (Hook.) Maxon, type.
- 6. — var. *gyroflexum* (Christ).
- 7. — var. *areolatum* C. Chr. (EKMAN no. 4367).



## PLATE II.

*Scleroglossum*. Venation and sections of

- Fig. 1. *S. debile* (Mett.) v. A. v. R.  
- 2. *S. pusillum* (Bl.) v. A. v. R. (sterile and fertile portion).  
- 3. *S. intermedium* (Cop.) C. Chr.  
- 4. *S. angustissimum* Cop.  
- 5. *S. sulcatum* (Kuhn) v. A. v. R.  
- 6. *S. wooroonooran* (Bailey) C. Chr.  
- 7. *S. minus* (Fée) Cop.  
- 8. *S. crassifolium* (Bak.) C. Chr. (fertile and sterile portion).



### PLATE III.

- Fig. 1. *Cochlidium graminoides* (Sw.) Klf. 4 leaves of the type-specimen, Herb. Swartz, nat. size, and fertile leaf-apex enlarged.
- 2a-c. *Cochlidium minus* (Jenm.) Maxon. *a* Portion of tuft of JENMAN's type (Kew), nat. size; *b*. from Porto Rico (HESS 313); *c*. from Cuba (POLLARD 340) with enlarged leaf-tip.
  - 3. *Cochlidium pusillum* (Massee) C. Chr. portion of the type, nat. size, and conduplicate and flat fertile leaves, enlarged.
  - 4. *Loxogramme acroscopum* (Christ) C. Chr. leaf from the type, nat. size.
  - 5a-b. *Loxogramme graminoides* (Bak.) C. Chr. *a*. from Yunnan (DELA-VAY); *b*. type of *L. spatulata* Cop. from Hupeh (WILSON 670), nat. size.
  - 6. *Loxogramme microphylla* C. Chr. portions from the type.
  - 7. *Oreogrammitis Clemensiae* Cop. Type, nat. size and fertile leaf  $\times 2$ .

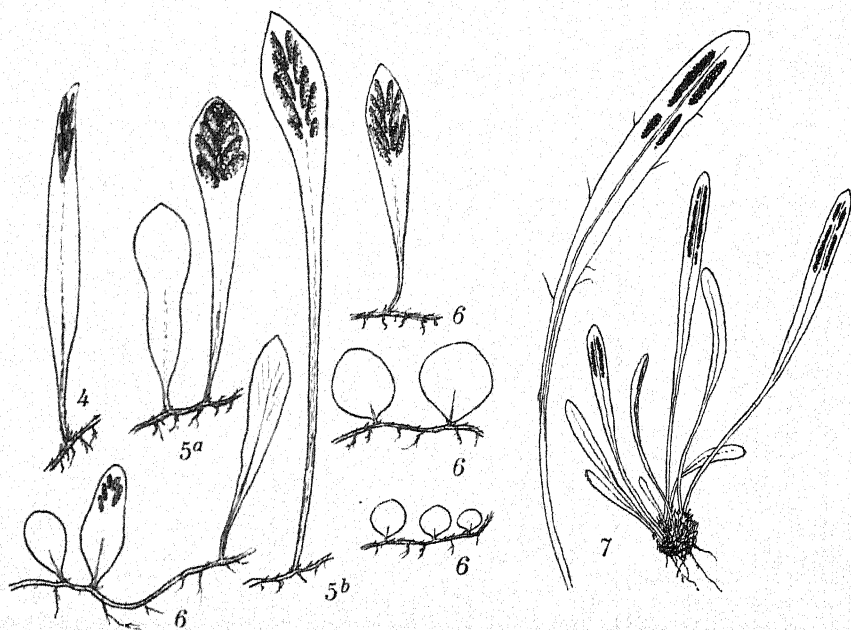
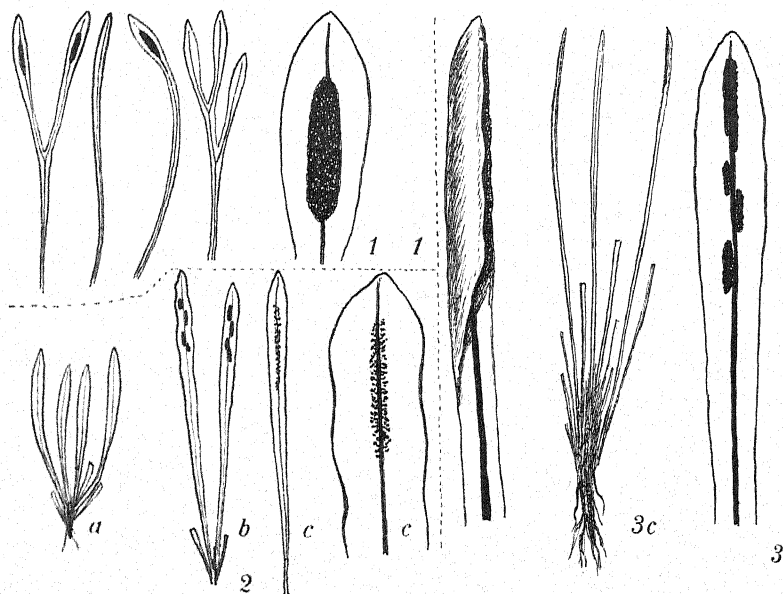


PLATE IV.

- Fig. 1. *Scleroglossum debile* (Mett.) v. A. v. R. Portion of tuft, nat. size. (Johore, HOLTUM no. 17493).
- 2. *Scleroglossum pusillum* var. *angustissimum* (Cop.) C. Chr. 2 leaves of the type, nat. size.
  - 3. *Scleroglossum wooroonooran* (Bailey) C. Chr., nat. size.
  - 4-7. *Nematopteris pyxidata* v. A. v. R. 4, 2 leaves of the type, nat. size; 5. venation of sterile portion,  $\times 20$ , drawn after a fragment prepared in glycerine during 3 months; in the newly soaked leaf the veins are nearly invisible, appearing as very faint lighter stripes. 6—7 Sections of sterile and fertile portion.  $\times 20$ .
  - 8-12. *Nematopteris interrupta* (Bak.) C. Chr. 8. One leaf (the larger) of BAKER's type and one of the type of *Polypodium pyxidiforme* v. A. v. R., nat. size; 9. section of the sterile and 10—11 two sections of the fertile portion,  $\times 20$ ; 12. annuli of sporangia with horn-like setæ.
  - 13. *Grammatopteridium costulatum* var. *Beguinii* (v. A. v. R.) C. Chr. Section of fertile leaf,  $\times 25$ .

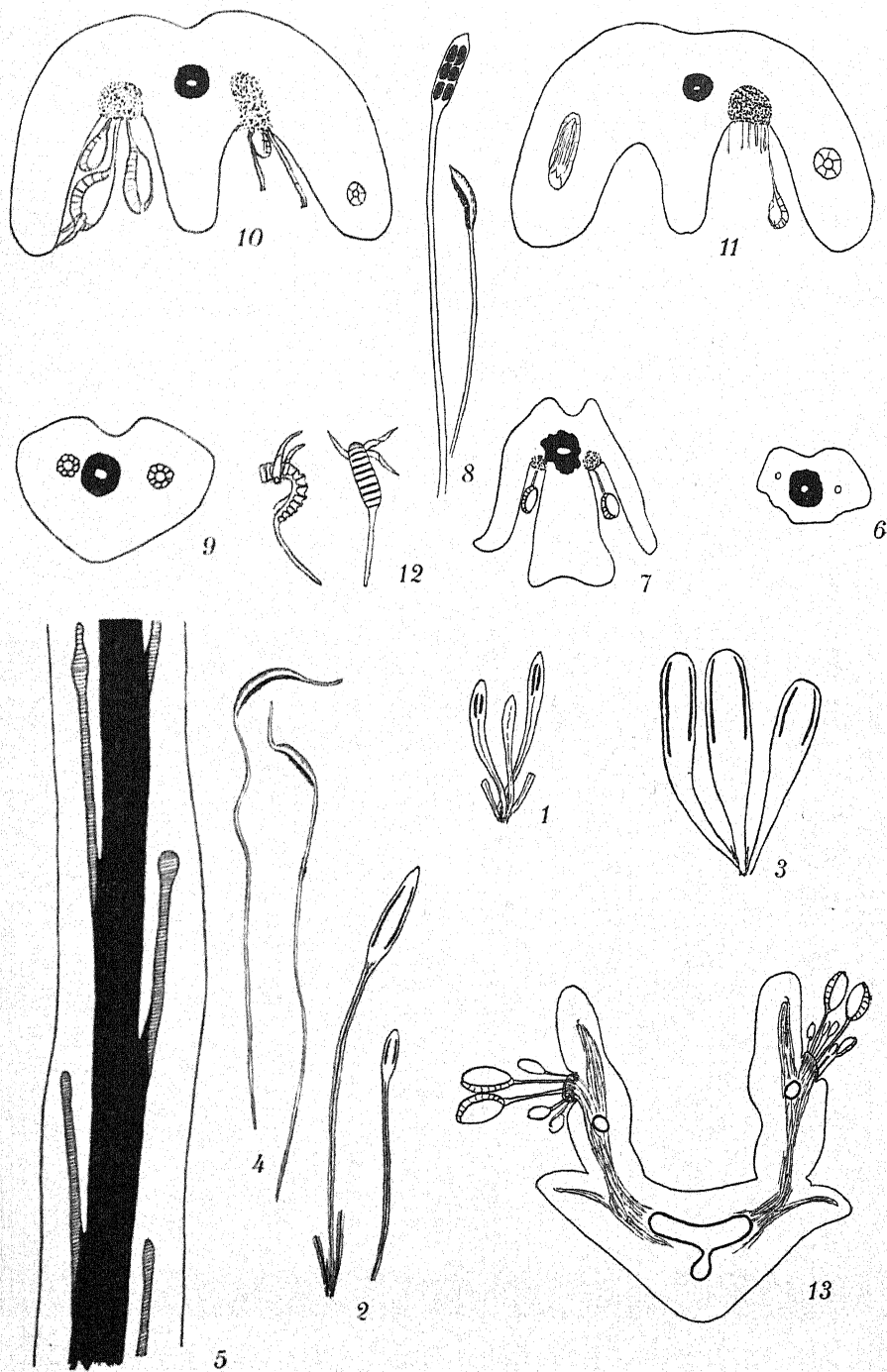


PLATE V.

*Lemmaphyllum*. All figures about nat. size.

- Fig. 1. *L. microphyllum* Pr. Typical forms from Japan.
- 2. The same from Hongkong, slightly scaly; 3 leaves from the same rhizome.
  - 3a-c. *L. microphyllum* var. *obovatum* (Harr.); cotype-specimens I. STEERE (W); c. leaf with polypodioid sori.
  - 4. *L. microphyllum* var. *lutchuense* (Nakai); 3 leaves from the same rhizome.
  - 5. *L. squamosum* C. Chr.
  - 6. *L. spathulatum* Pr. from Luzon (WILLIAMS 1580).
  - 7a-d. *L. carnosum* (Wall.) Pr.; a. from Yunnan (HENRY 9869 B); b. from Assam (I. MANN); c-d. from Yunnan (ROCK 7957a).
  - 8a-c. *Polypodium drymoglossoides* Bak. a. from Kweichow (ESQUIROL 627), b. short fertile leaf I. FABER; c. long fertile leaf from Fukien.
  - 9. *Polypodium moupinense* Franch., type I. DAVID.

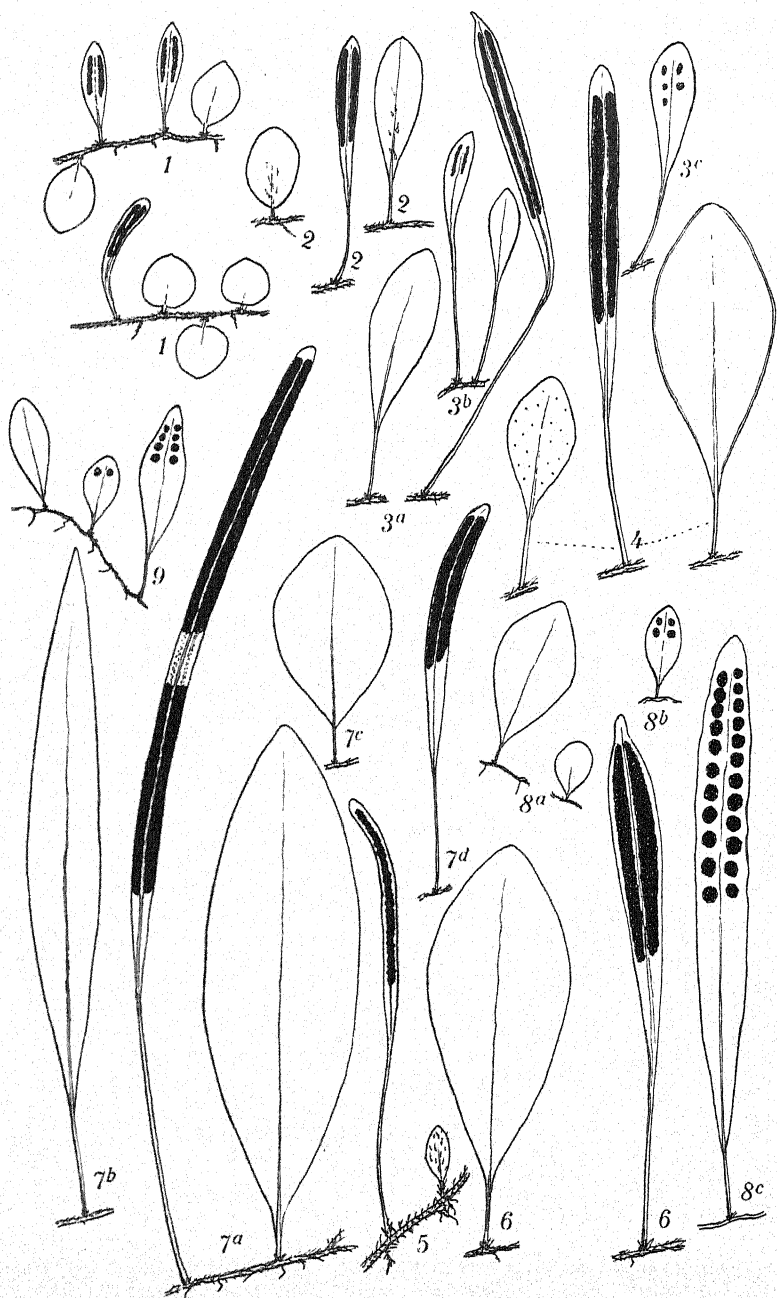
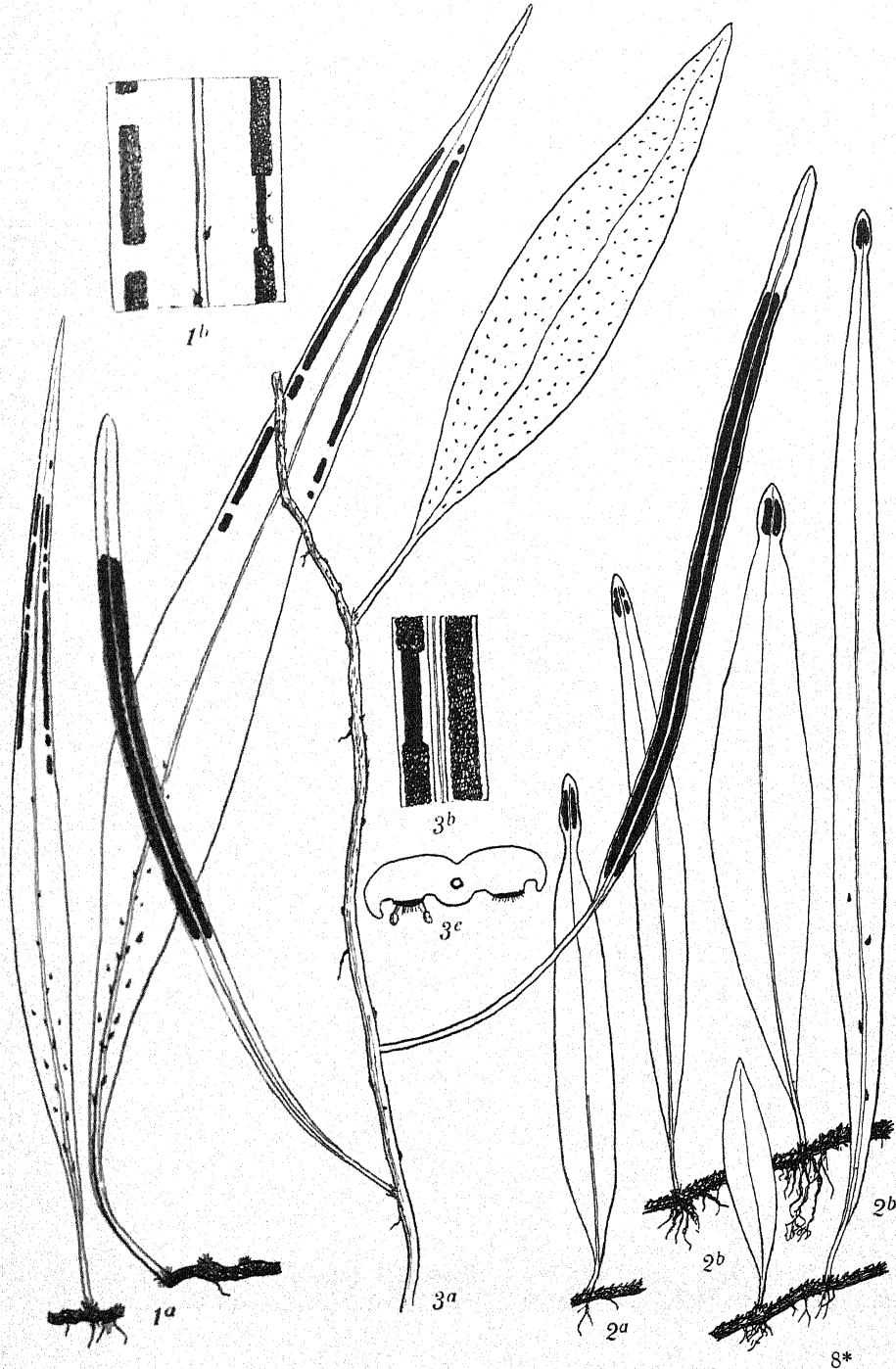


PLATE VI.

Fig. 1a-b. *Lemmaphyllum sinense* (Christ) C. Chr. *a.* 2 leaves nat. size, the smaller from the type (HENRY), the larger, Rock no. 7365; *b.* fragment  $\times 2$ .

- 2a-b. *Lemmaphyllum abbreviatum* (Fée) C. Chr., nat. size; *a.* leaf of CHRIST's type (CADIÈRE 97); *b.* 4 leaves of CADIÈRE 100.
- 3a-c. *Marginariopsis Wiesbaurii* Sod.; *a.* a specimen in Herb. Budapest, leg. SODIRO nat. size, the sterile leaf seen from the upperside; *b.* fragment; *c.* section of fertile leaf, enlarged.



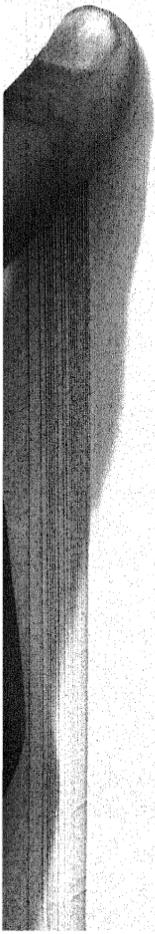


PLATE VII.

- Fig. 1-2. Venation of sterile and fertile portion of *Paltonium vittariiforme* Ros.  
- 3. Venation of *Polypodium eilophyllum* Diels.  
- 4. Venation of *Drymotaenium Miyoshianum* Makino; *b.* of apex.

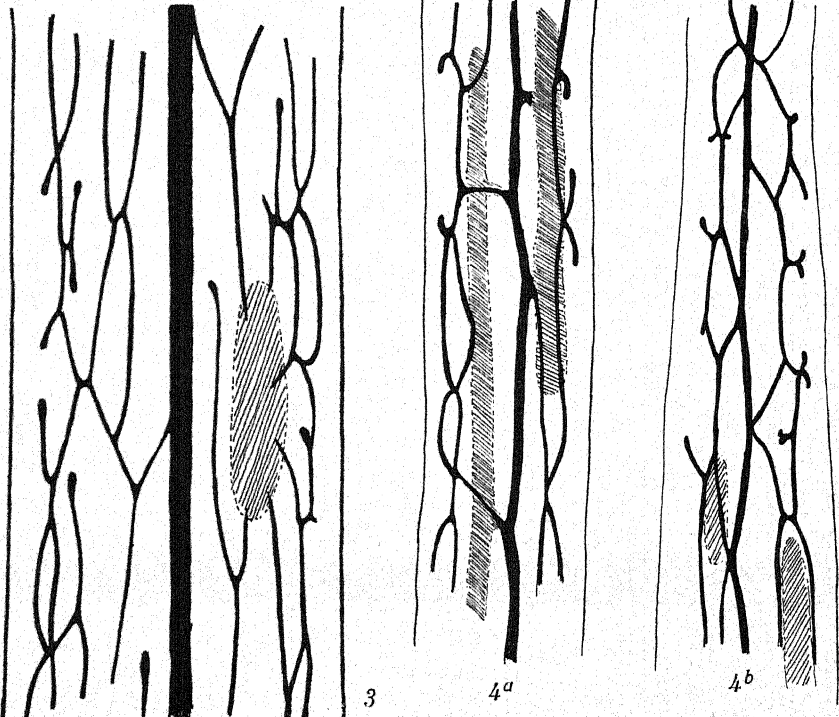
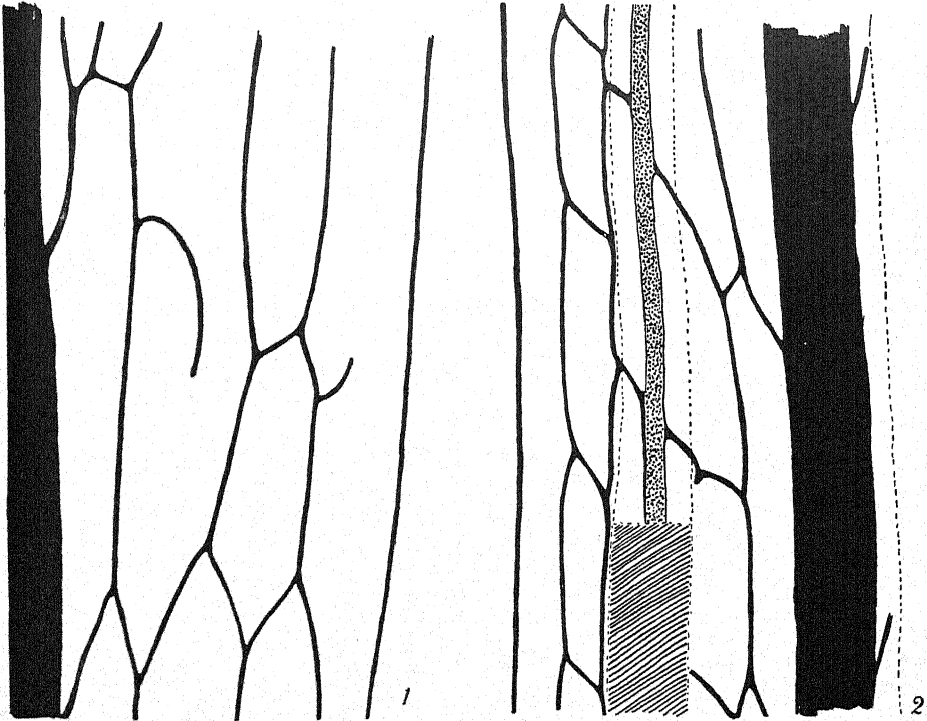


PLATE VIII.

Fig. 1a-b. *Pycnoloma rigidum* (Hook.) C. Chr. *a.* Normal sterile leaf and tip of fertile leaf, nat. size, with the latter enlarged. *b.* Portion of a specimen of the same showing transitions between sterile and fertile leaves, nat. size.

- 2. Section of the fertile leaf of the same,  $\times 25$ .
- 3. *Pycnoloma metacoelum* (v. A. v. R.) C. Chr. Section of a fertile leaf,  $\times 25$ .
- 4-6. *Pycnoloma murudense* C. Chr. 4. Portion of type-specimen, nat. size. 5. Venation and 6. section of fertile leaf.
- 7. *Grammatopteridium costulatum* (C. Chr.) C. Chr. forma, Sterile and fertile leaf, nat. size, LEDERMANN no. 11215.

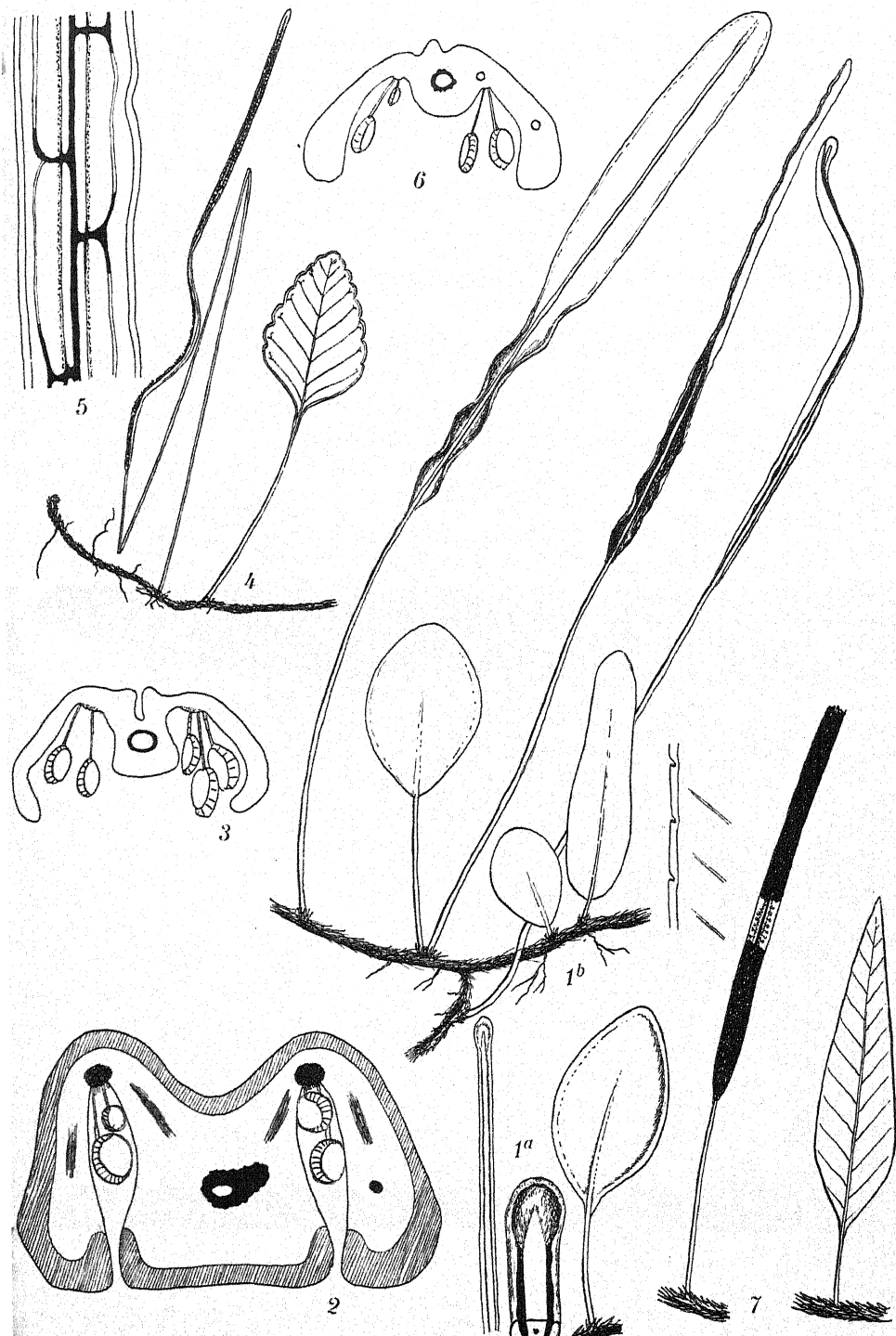


PLATE IX.

- Fig. 1. *Myuropteris cordata* (Christ) C. Chr., type-specimen, nat. size, with enlarged fragment of the fertile leaf.
- 2. *Pycnoloma metacoelum* (v. A. v. R.) C. Chr. HANS WINKLER no. 1499, nat. size.
  - 3. *Polypodium Hagerupii* C. Chr., type-specimen, nat. size, with enlarged fragment of fertile leaf and of notched margin of the sterile one.



PLATE X.

Venation of sterile leaves ( $\times 4$ ) of

- Fig. 1. *Pycnoloma rigidum* (Hook.) C. Chr.  
- 2. *Pycnoloma metacoelum* (v. A. v. R.) C. Chr.  
- 3. *Myuropteris cordata* (Christ) C. Chr.  
- 4. *Pycnoloma murudense* C. Chr.

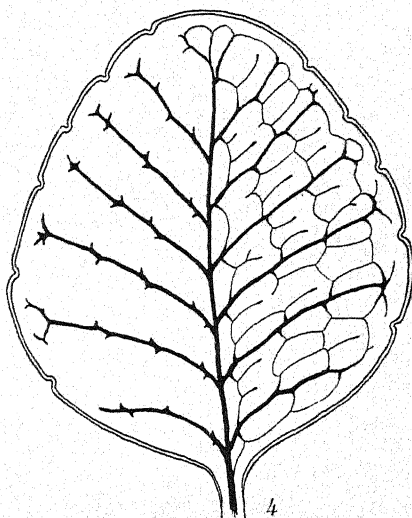
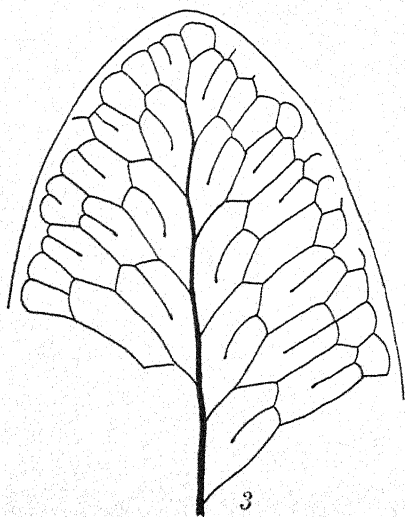
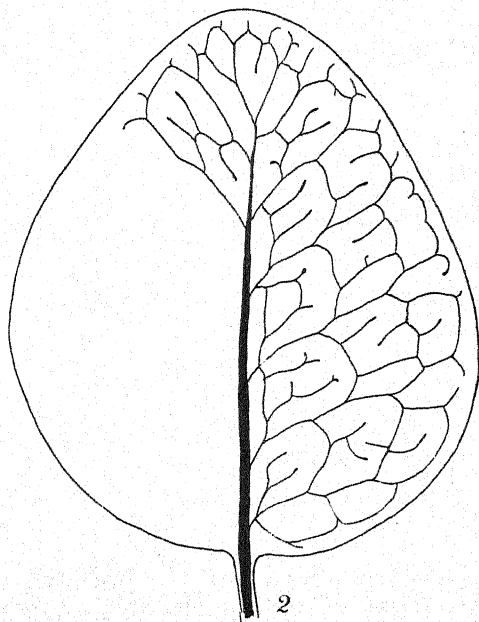
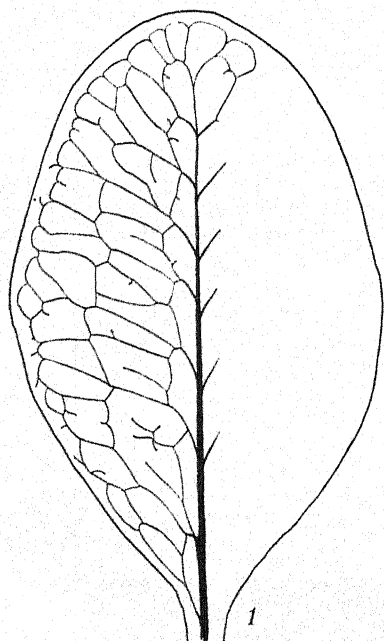


PLATE XI.

- Fig. 1. Type-specimen of *Grammatopteridium Brooksii* v. A. v. R., nat. size.  
- 2. *Drymoglossum novoguineae* Christ, l. NYMAN, nat. size. 2a Fragment  
of fertile leaf,  $\times 8$ .



PLATE XII.

Fig. 1. *Drymoglossum heterophyllum* (L.) C. Chr., nat. size.

- 2a-c. *Drymoglossum heterophyllum* var. *Beddomei* (Clarke). *a*. Two sterile and two fertile leaves of CLARKE's type (*Kew*). *b*. Portion of WRIGHT 3173 (*Le*). *c*. Subdimorphous leaves of a specimen from Cochin I. RENGASHARI (*Kew*). All nat. size.
- 3. *Drymoglossum crassifolium* Brause (SCHLEGHTER 19874); nat. size.
- 4-8. Sections of fertile leaves  $\times 10$  of: 4-5. *D. piloselloides* (L.) Pr. (4. of living leaf from Botanical Garden, Copenhagen, 5. of dried leaf). 6. *D. heterophyllum* (L.) C. Chr. (dried, wrinkled leaf); 7. *D. fallax* v. A. v. R. (from the type of *D. Schlechteri* Brause); 8. *D. nipholoides* (Lueress.) Bak.

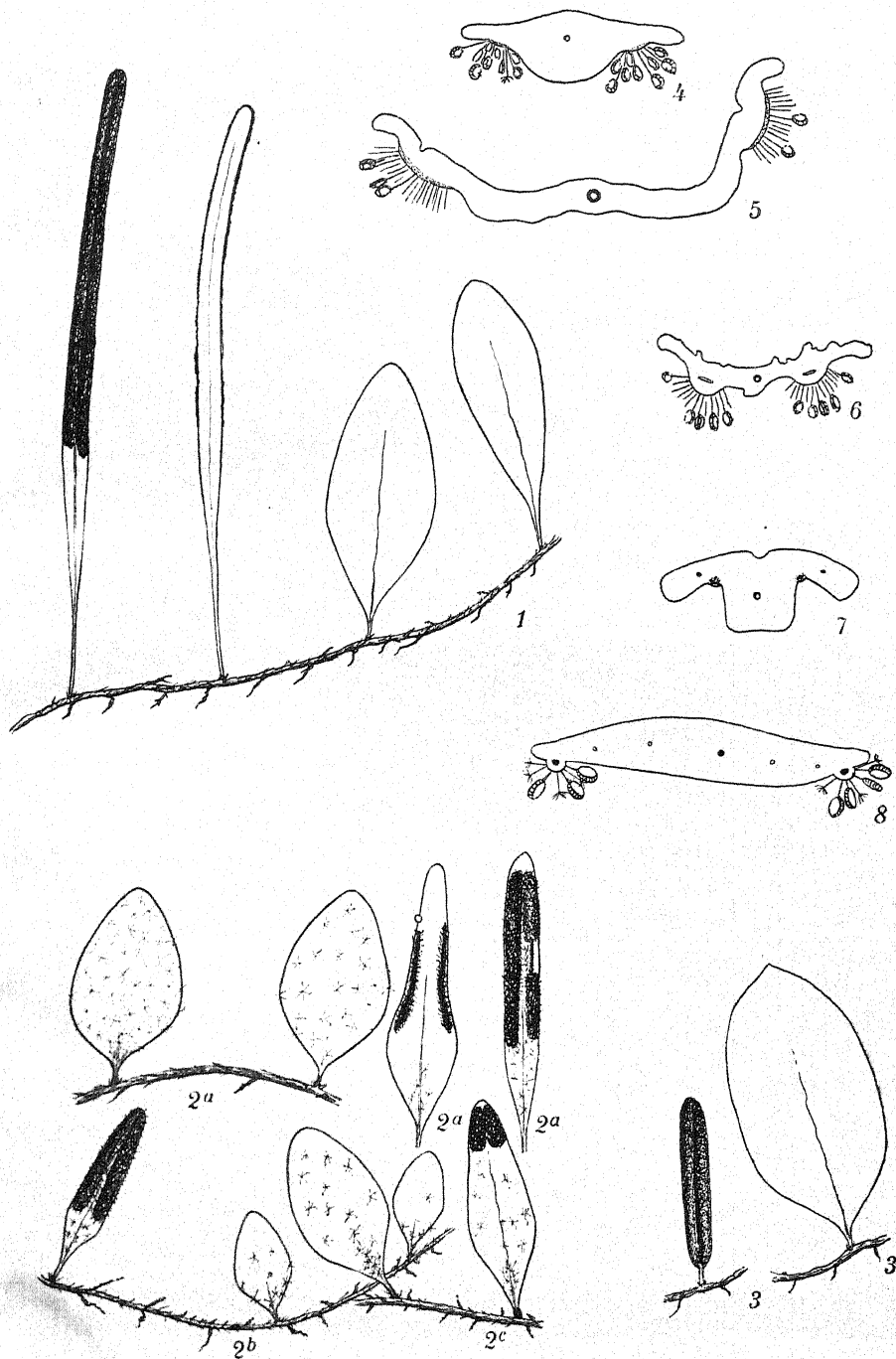
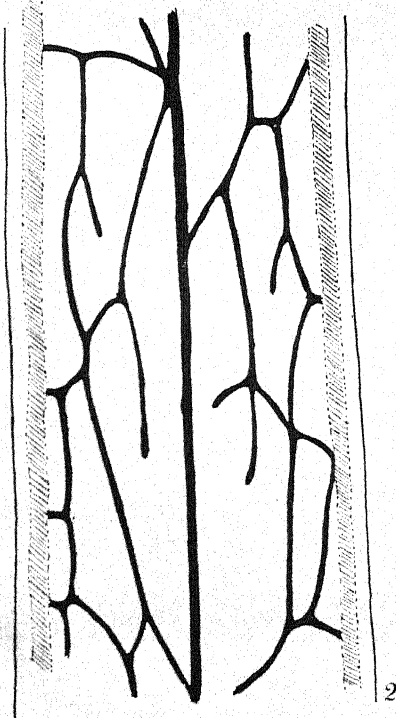
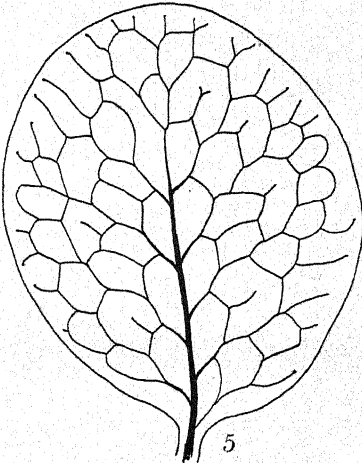
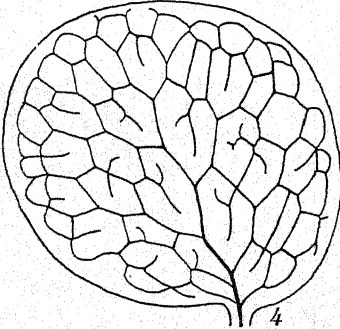
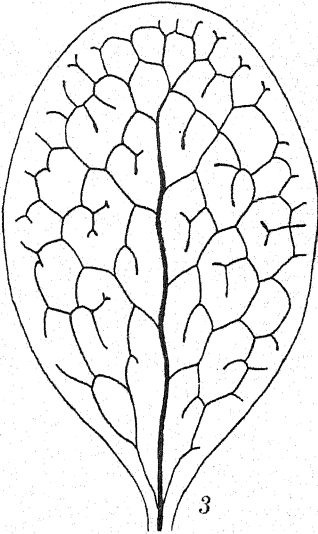
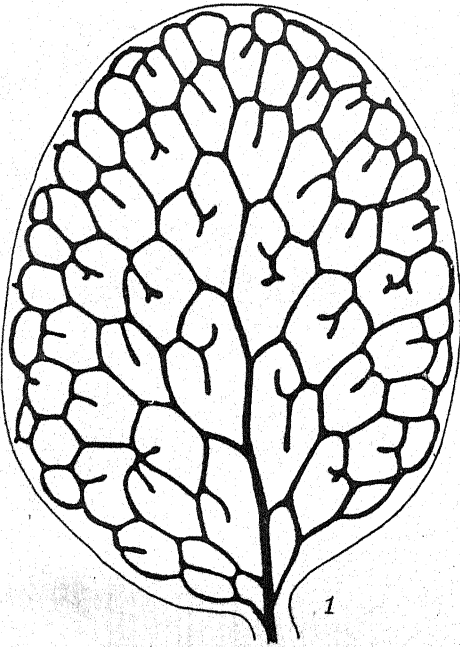


PLATE XIII.

Venation of *Drymoglossum*.

- Fig. 1. *D. niphoboloides* (Luerss.) Bak. short, roundish leaf,  $\times 4$ .  
- 2. Fragment of fertile leaf of the same,  $\times 10$ .  
- 3. *D. heterophyllum* (L.) C. Chr.  $\times 4$ .  
- 4. *D. piloselloides* (L.) Pr., small, roundish leaf,  $\times 4$ .  
- 5. *D. fallax* v. A. v. R. (*D. Schlechteri* Brause),  $\times 4$ .



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